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& ΓΕΩΤΕΧΝΙΚΗΣ
ΜΗΧΑΝΙΚΗΣ

Τα Νέα

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Importance of digital asset information. The project's dual deliverables: physical and digital

Digital information about physical infrastructure, such as airports, roads, railways and stations can be used by long-term owners and operators to improve operational performance and sustainability. Thus owners are beginning to procure both physical infrastructure and the related digital asset information. They see their investment in infrastructure projects as adding value through this dual output, with both a physical and digital deliverable.

This requires changes in the supply-side, as it becomes an information-intensive, and seeks to collate reliable digital asset information during the project; to handover this information to owners and operators and to work with them as they takeover responsibilities for management of this information. Such handover is vital to achieving the ambitions of the UK government BIM agenda.

Information integration and hand-over

Where infrastructure programmes have an organization that operates as the delivery client, this handover can have two parts, with: first, a handover of as-built information from project or sub-project supply-chains; and its approval, collation and integration at the programme-wide level; and second, a handover of as-built information collated at the program-

(συνέχεια στην σελίδα 3)

Π Ε Ρ Ι Ε Χ Ο Μ Ε Ν Α

Dolomites

Flipping into pool glacier

Grand Canyon

(συνέχεια από την πρώτη σελίδα)

me level to the long-term owner and operator.

Effective handover of digital asset information

1. Systems integration

Challenges of the first handover of as-built information from project supply-chain to the programme-wide level are:

- Obtaining high quality information from the supply-chain towards the end of construction;
- Collating and checking information before teams disband; and
- Controlling changes to requirements and information.

These challenges can be addressed through progressive build-up of information through the life of the project, with a structured set of meetings; deliverables; and responsibility matrices understood through a 'time minus' process to manage timely delivery of digital asset information.

Training is needed to ensure the supply chain understands information requirements; and can implement meta-data and content checks for document compliance. This process should start early in the project. Assumptions regarding the time taken to check and approve information from the supply chain need to be tested. In the systems integration phase, a change control process is needed to control changes to requirements and digital asset information. Completeness of documentation should be monitored with different resource scenarios to avoid resource escalation as key people and organizations leave in the project close-out phase.

2. Handover to the owner operator

Challenges of the second handover of as-built information from the project or programme to the owners and operators are:

- Extraction of data to owner-operator systems;
- Establishing practices for managing change and maintaining the "single source of truth";
- Understanding (evolving/shifting) requirements for operation; and
- Timing of data handover

The takeover of information by the owners and operators is different from the handover of information from the supply chain. There is a need for the supply-side to work with and help owner-operator teams in upskilling to takeover digital asset information; and in the extraction of data to owner-operator systems, which should be piloted and checked before batches of information are transferred.

The operator needs information to be delivered alongside physical assets. The operator needs understanding of the project as an investment, with a business plan beyond infrastructure delivery and interests in operational readiness; commercial launch; change control; and planning for next generation support for digital asset information.

For further information please contact the author: Jennifer Whyte (j.whyte@imperial.ac.uk).

Trift Bridge, Gadmen, Switzerland, 5.6 km long

Sólheimajökull, Iceland

Courmayeur, Italy

Antrium, Northern Ireland Giants Causeway - Basalt

ΑΡΘΡΑ

Παρουσίαση άρθρων, στην συγγραφή των οποίων μετείχαν Έλληνες, στο XVI European Conference on Soil Mechanics and Geotechnical Engineering, Edinburgh, 13-17 September 2015 (κατ' αλφαβητική σειρά, στα ελληνικά, του ονόματος του πρώτου συγγραφέα).

Soil-structure interaction in levees with cutoff walls founded on liquefiable soils Interactions

Sol - Structure dans les Digues avec des Parois d'étanchéité Fondées sur des Sols Liquéfiables

A.J. Lobbestael and A. Athanasopoulos-Zekkos

ABSTRACT Many levee systems include embedded cutoff walls in order to protect against failures associated with excessive under- and through-seepage. Recent studies have indicated that a large number of existing levees are vulnerable to seismic activity, with one of the primary sources of this vulnerability being the potential liquefaction of the levee foundation soils. The interaction between a levee cutoff wall and liquefiable soils however, is not well understood. The numerical analyses presented in this paper provide insight into how a cutoff wall interacts with surrounding liquefiable soils, how it affects the triggering of liquefaction, and how it affects the overall dynamic response of the levee system. Fully nonlinear numerical analyses are conducted using the finite difference software FLAC. The UBCSAND model was used to capture excess pore pressure generation and subsequent liquefaction. A levee founded on liquefiable soils is modeled with a) no cutoff wall and b) a steel sheet pile cutoff wall and is subject to a recorded ground motion. The effects of the presence of the cutoff wall on the triggering and progression of liquefaction, as well as levee displacements and response are presented.

1 INTRODUCTION

In recent years, levee systems throughout the United States have undergone extensive investigation, revealine that seismic activity and liquefaction potential pose serious risks to many existing levees. This highlights the importance of having guidelines and recommendations for the seismic design and evaluation of levees. Significant energy has been devoted to this

need and several documents and publications have recently been produced that present such guidelines (e.g. ILH 2013; Shewbridge et al 2009; USACE 2013). However, these guidelines do not address cutoff walls, which are included in many levees to protect against excessive under- and through-seepage. This paper presents a set of numerical analyses of levees founded on liquefiable soils, in order to investigate the effects that a cutoff wall has on the dynamic response of a levee.

2 NUMERICAL MODEL VALIDATION AND INPUT

In order to investigate the effect of cutoff wall presence on the dynamic response of an earthen levee founded on liquefiable soils, fully nonlinear numerical analyses were conducted using the finite difference numerical modeling software FLAC – Fast Lagrangian Analysis of Continua (Itasca 2011). A set of validation tests, described in the following section, were first performed to verify that the constitutive model was accurately calibrated to capture soil liquefaction. This is followed by a description of the numerical input and analysis used to investigate the dynamic response of the levee system.

2.1 Numerical Model Validation

In the analyses, potentially liquefiable soils were modeled using the UBCSAND constitutive model (Byrne et al 2004; Beaty and Byrne 1998), which is an advanced effective stress plasticity model with the ability to capture excess pore pressure generation during shaking. In order to verify that the UBCSAND model was properly calibrated and capturing soil liquefaction and pore pressure generation during shaking, a set of validation analyses were conducted and compared to a simplified liquefaction triggering assessment procedure. A level ground profile was modeled in FLAC with 12 meters of medium dense sand with silt, underlain by 3 meters of loose sand, underlain by 18 meters of dense sand. The embedded layer of loose sand was modeled with the UBCSAND constitutive model.

Two input ground motions were selected from the PEER NGA ground motion database (PEER 2011), such that, when used as input for the simple ground profile, one should result in liquefaction and one should not. Using the SPT-based liquefaction triggering correlation proposed by Seed et al (1984), one ground motion was selected with characteristics resulting in greater than 95% probability of liquefaction and one ground motion was selected with characteristics resulting in less than 5% probability of liquefaction. The selected motions were Cape Mendocino (NGA0829) and Hector Mine (NGA1795), respectively.

To identify which zones experienced liquefaction during the simulation, excess pore pressure ratios, were computed according to the following equation:

$$r_u = \frac{u - u_0}{\sigma'_{v0}}$$

where u is the instantaneous pore pressure, u_0 is the initial pore pressure, and σ'_{v0} is the initial vertical effective stress. Based on recommendations of the developers of the UBCSAND constitutive model, zones with excess pore pressure ratios in excess of 0.7 were considered to be liquefied. According to this criteria, the analysis with the Cape Mendocino input motion resulted in complete liquefaction of the loose sand layer and the analysis with the Hector Mine input motion resulted in no liquefaction. These results agree with the simplified liquefaction triggering assessment and provided confidence that the UBCSAND model was accurately modeling soil liquefaction.

2.2 Numerical Model Input

A levee profile was then modeled without a cutoff wall and with a steel sheet pile cutoff wall. The models were subject to a single recorded earthquake ground motion, selected from the NGA ground motion database, Big Bear – 01 (NGA 0901). The acceleration time history of the input motion is presented in Figure 1. The geometry of the levee profile and foundation stratigraphy that were analyzed were selected to be representative of typical earthen levees and subsurface site conditions in California. The dimensions of the levee were a height of 10.7 meters and a crest width of 9 meters, with symmetrical 3:1 (H:V) slopes. Investigation data of sites that were observed to have liquefied during the 1979 Imperial Valley earthquake, documented by Youd and Bennett (1983) was used as a basis for selection of the stratigraphy and strength parameters of the foundation soils. Figure 2 presents the geometry of the levee and foundation soil stratigraphy. For the analysis with a sheet pile cutoff wall, the wall was placed at the center of the levee and extended into the foundation soil, to a depth of 19.8 meters below the levee crest. The water conditions were modeled at 4.6 meters of water outside of the water side slope and level with the ground surface on the landside of the levee. The phreatic surface within the levee was determined by a numerical seepage analysis.

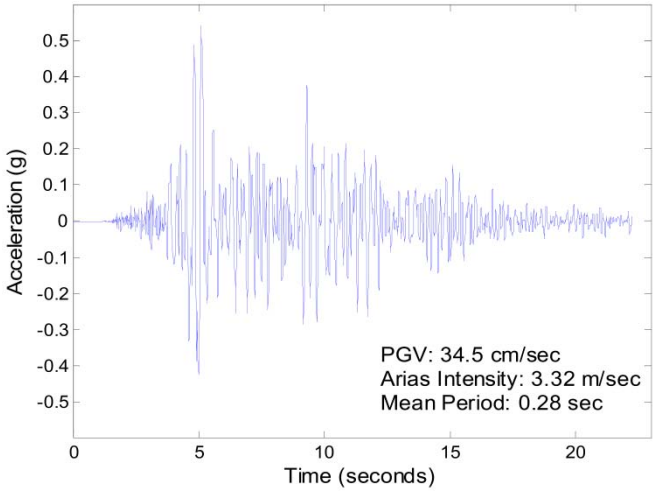

Figure 1. Acceleration-time history of input ground motion.

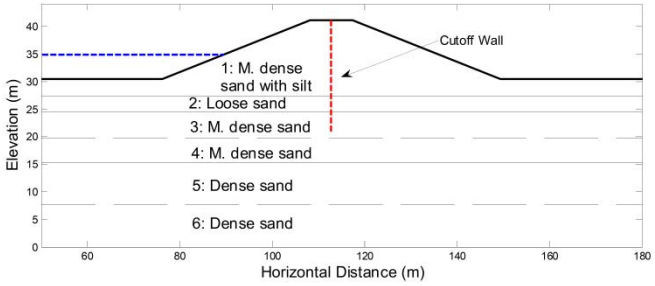

Figure 2. Levee geometry and foundation soil stratigraphy.

A variety of constitutive models were used throughout the analyses to capture the various soil and material behaviors. For calculation of the initial stress state, all soils were modeled with an elastic, perfectly-plastic model with yielding defined by the Mohr-Coulomb failure criterion. For the dynamic portion of the analysis, the potentially liquefiable soils in the foundation were modeled using the UBCSAND model. A set of generic input parameter relationships for UBCSAND version 904aR were used to determine the model parameters, based on relative density index. For the post-liquefaction portion of the analysis, liquefied soils were modeled with the Mohr-Coulomb model using parameters reflecting liquefied residual strengths. The steel sheet pile wall was modeled using linearelastic beam elements with properties reflecting an intermediate sheet pile, typical of what may be used for a levee cutoff wall. The cutoff wall elements were attached to the surrounding soil with unglued interfaces, allowing for relative slip and separation. Table 1 presents the model parameters used in the analyses.

For both analyses, an initial stress state was determined, followed by the dynamic analysis of the earthquake motion and a post-liquefaction analysis. The initial stress condition was calculated by first initializing pore pressures and stresses for level ground conditions with the ground water table at the ground surface. The levee was then placed and the model was stepped to equilibrium with a surcharge outside of the slope, reflecting the water on the waterside of the levee. The phreatic surface and pore pressure distribution within the levee were then determined with an uncoupled seepage analysis. After the flow calculation, effective stresses were adjusted to reflect the new pore pressures and the model was again stepped to equilibrium.

Following calculation of the initial stresses, a fully coupled fluid-mechanical dynamic analysis was performed to simulate an earthquake. Free field boundaries were applied to the lateral extents of the model and the base was modeled as an absorbing boundary. The motion was applied as a stress-time history at the base of the model. This models a

Table 1. Material models and paramters.

Mohr Coulomb Material Model			
Soil Layer	1	2	3
Friction Angle (°)	35	33	36
Cohesion (kPa)	4.8	0	0
Elastic Modulus (kPa)	2.74e5	2.39e5	2.74e5
Poisson's Ratio	0.3	0.3	0.3
Dry Unit Weight (kN/m^3)	17.3	17.3	17.3
Soil Layer	4	5	6
Friction Angle (°)	38	39	40
Cohesion (kPa)	0	0	0
Elastic Modulus (kPa)	2.74e5	3.36e5	3.36e5
Poisson's Ratio	0.3	0.3	0.3
Dry Unit Weight (kN/m^3)	17.3	18.1	18.1
Fluid Flow Model Properties			
Soil Layer	1	2	3
Porosity	0.29	0.35	0.29
Hydraulic Conductivity (cm/s)	3.1e-3	1.5e-2	9.1e-3
Soil Layer	4	5	6
Porosity	0.29	0.28	0.28
Hydraulic Conductivity (cm/s)	9.1e-3	2.3e-3	2.3e-3
UBCSAND Material Model			
Soil Layer	2	3	4
n160, relative density index	15	26	31
pa, atmospheric pressure (kPa)	101.3	101.3	101.3
kge, G_max/pa	1069	1284	1362
ne, shear stiffness power	0.5	0.5	0.5
kb, B/m_pa	748.6	899	953.3
me, bulk modulus power	0.5	0.5	0.5
kgp, plastic shear modulus num	822	2705	4026
np, plastic shear stiff. power	0.4	0.4	0.4
rf, hyperbolic fitting coeff.	0.73	0.67	0.66
phicv, c.v. friction angle	33	36	38
phif, max mobilized friction	34.5	40.8	44.3
Sheet Pile Cutoff Wall			
Moment of Inertia (m^4)	2.16e-4		
Area (m^2)	1.87e-4		
Elastic Modulus (kPa)	2.11e8		
Density (kg/m$^{3)}$	7.73e4		

vertically propagating shear wave and a compliant base (Mejia and Dawson 2006). To account for material damping of the ground motion, a 4-point sigmoidal hysteretic damping model was applied to the non-UBCSAND constitutive model zones. (Hysteretic damping is inherent in the UBCSAND model.) The properties of the hysteretic damping model were calibrated to match modulus reduction and damping curves of sands, presented by Seed and Idriss (1970).

Following the dynamic portion of the modeling, analysis was conducted to predict post-liquefaction displacements. At the end of the ground motion input, Rayleigh damping was increased to 5% and dynamic time was continued, to allow the velocities within the model to dissipate. Constitutive model zones that were determined to have liquefied during

the ground motion were changed to an elastic, perfectly-plastic model with liquefied residual strengths computed using Stark and Mesri's strength ratio (1992):

$$\frac{S_{u(crit)}}{\sigma'_{v0}} = 0.0055 * (N_1)_{60-CS}$$

where $S_{u(crit)}$ is liquefied residual strength, σ'_{v0} is the initial vertical effective stress and $(N_1)_{60\text{-}CS}$ is the standard blow count corrected for overburden pressure and fines content. Based on empirical results presented by Seed and Harder (1990), the residual strengths were not assigned lower than 12 kPa. The elastic shear stiffness of the liquefied zones was assigned a value of 10 times the liquefied residual strength (after Stark et al 2012). After assigning liquefied strengths, dynamic time was continued until a stable post-liquefied equilibrium state was reached.

3 ANALYSIS RESULTS

The results of the numerical analysis for the levee with a steel sheet pile cutoff wall are compared to the results for the levee with no cutoff wall to identify what effect the cutoff wall has on the dynamic response of the levee. The effect of the wall presence is presented in terms of liquefaction triggering and resulting displacements

3.1 Liquefaction Development

At the end of the dynamic portion of the analyses, excess pore pressure ratios were observed to determine the extent of soil liquefaction in the foundation soils. Figure 3 presents excess pore pressure ratio contours for both analyses (with and without a cutoff wall), indicating the extent of soil liquefaction. As seen in the figure, for the levee with no cutoff wall, in the free field, all of the liquefiable soils (soils modeled with UBCSAND) experienced liquefaction. Beneath the levee however, the soils did not liquefy, due to the additional liquefaction resistance provided by the overburden pressure of the levee. The uppermost layer of liquefiable soils (the loosest material) experienced the most liquefaction beneath the levee, extending beneath the levee slopes.

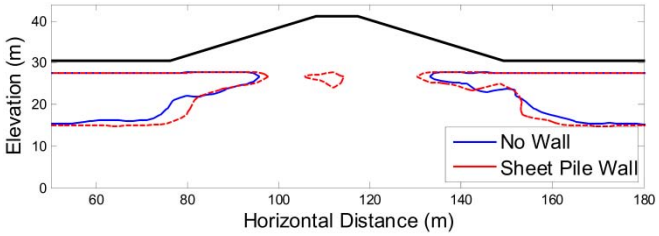

Figure 3. Liquefaction extents at the end of shaking for levee with and without a cutoff wall.

Comparison of the liquefaction extents for the cutoff wall analysis with the no-cutoff wall analysis indicate differences resulting from the wall presence. The liquefaction extents with a cutoff wall are largely the same as with no cutoff wall, but they are seen to extend slightly further beneath the levee. Also, there is a zone of liquefied material adjacent to the cutoff wall, that was not observed for the analysis with no cutoff wall.

In order to further compare the liquefaction development for the two analyses, Figure 4 presents time histories of the percentage of liquefiable zones that experienced liquefaction during the shaking. The difference in percentage of zones experiencing liquefaction between the two analyses grows steadily throughout the intense shaking portion of the input motion, suggesting a persistent difference between the two cases, as opposed to an isolated characteristic of the ground motion that results in the difference in liquefaction. Furthermore, the time histories indicate that the levee with a cutoff wall has more extensive liquefaction throughout the duration of the motion.

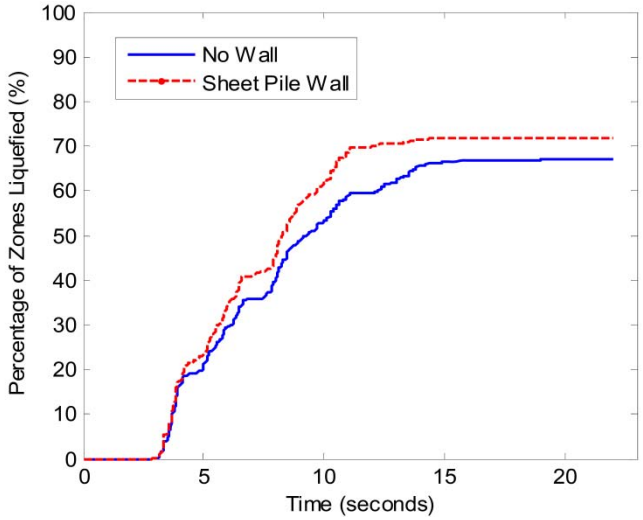

Figure 4. Time histories of percentage of zones which experienced liquefaction.

The difference in liquefaction behavior between the two cases may be the result of either differences in forces resisting liquefaction or differences in forces driving liquefaction. With regard to liquefaction resistance, the presence of a cutoff wall forces the potential landside slope failure plane to the landside of the levee, altering the static stresses within the levee and foundation. Static horizontal shear stresses have been shown to alter a soil's liquefaction resistance (Harder and Boulanger 2007). The wall also alters the distribution of pore pressures within the levee, and thereby alters the initial effective stresses. On the waterside of the cutoff wall, the phreatic surface is higher than for a levee with no cutoff wall, resulting in lower effective stresses. It is also possible, that during the earthquake motion, the presence of the wall limits excess pore pressure dissipation, furthering liquefaction.

To investigate potential differences in liquefaction driving forces between the two cases, profiles of a liquefaction driving force parameter, equivalent cyclic stress ratio, CSR_{eq} were plotted at various locations within the levee and free field, with CSR_{eq} defined as:

$$CSR_{eq} = 0.65 * \frac{\tau_{max}}{\sigma'_{v0}}$$

where τ_{max} is the maximum shear stress and σ'_{v0} is the initial vertical effective stress. Maximum values of this ratio were observed throughout the levee and foundation and were compared between the two cases. Very little to no difference in maximum equivalent cyclicstress ratio (less than 0.05) was observed betweenthe two cases. Based on these observations, it appearsthat the difference in liquefaction behavior betweenthe levee with a cutoff wall and no cutoff wall is theresult of differences in liquefaction resistance. Somecombination of the differences in resistance factors(i.e. static stress state, initial pore pressure distribution,pore pressure dissipation) results in more liquefaction for the levee with a cutoff wall, relative to the levee with no cutoff wall.

3.2 Seismic Displacements

Regarding the dynamic response of levees, the parameter of primary interest is the resulting displacements, particularly vertical displacements. Figures 5 (a) and (b) present the vertical displacements and horizontal displacements, respectively, across the ground surface, at the end of the ground motion, as well as once a stable post-liquefaction

state was reached. Comparison of the vertical displacements at the end of shaking between the two analyses shows that the levee with a cutoff wall experiences approximately 5% greater displacement relative to the levee with no cutoff wall.

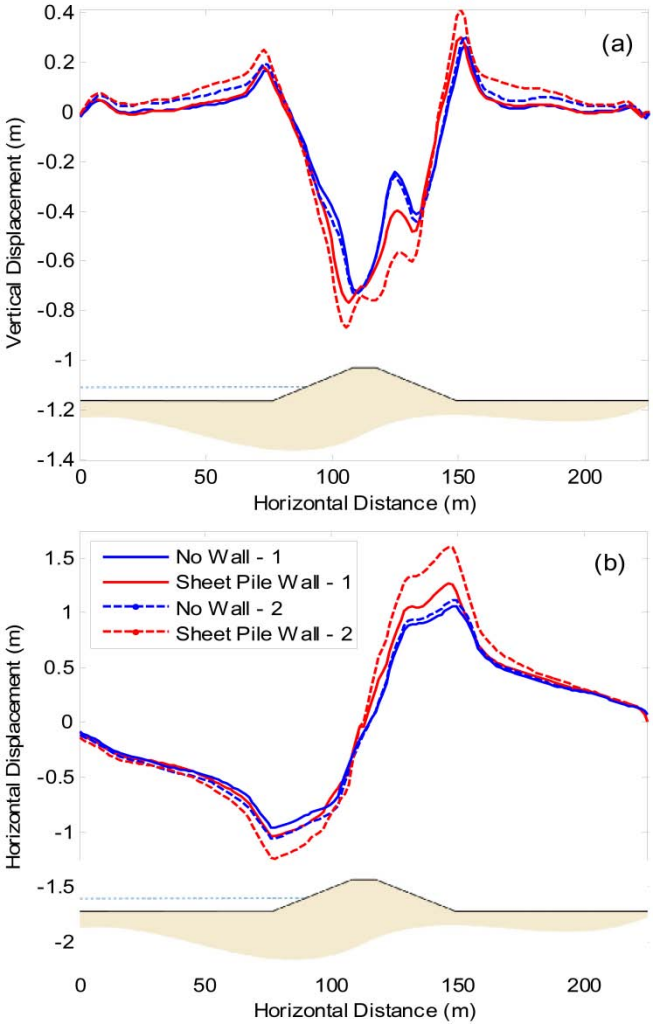

Figure 5. (a) vertical and (b) horizontal surface displacements at (1) the end of shaking and (2) stable post-liquefaction state.

Comparison of the post-liquefaction vertical displacements indicates that the levee with a cutoff wall experiences significantly greater post-liquefaction movement than the levee with no cutoff wall. The resulting post liquefaction freeboard loss is approximtaley 19% greater for the levee with a cutoff wall. These differences can be attributed to the more extensive liquefaction observed for the levee with a cutoff wall.

Simplified seismic slope displacement procedures typically estimate Newmark-type, horizontal displacements and suggest a conversion to vertical displacement by means of a standard ratio of vertical to horizontal displacements of 0.7 (e.g. Shewbridge et al 2009; USACE 2013). The ratio of vertical to maximum horizontal displacements observed for the levee with no cutoff wall are between 0.66 and 0.74 on both sides of the levee at both the end of shaking and the post-liquefaction state. For the levee with a cutoff wall however, the ratio ranges between 0.55 and 0.74. This ratio is a function of the failure geometry, which is altered by the presence of a cutoff wall. The difference in liquefaction also contributes to the difference in the value of the ratio. Therefore a single value for the ratio of vertical to horizontal displacements may not be appropriate.

4 CONCLUSIONS

A set of numerical analyses were conducted to investigate the effects that a cutoff wall has on liquefaction development and the dynamic response of a levee. The analysis results indicate that the presence of a cutoff wall results in more extensive liquefaction, than for a levee with no cutoff wall. This results in larger seismic displacements, which were observed to be as much as 19% greater for a levee with a cutoff wall. These observations highlight the importance of the inclusion of the effect of cutoff walls in guidelines for evaluating levees for seismic risk. However, further study is needed, since this is a limited study, with only one ground motion input and one levee geometry.

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An overview of research activities and achievement in Geotechnics from the Scottish Universities Geotechnics Network (SUGN)

Une vue d'ensemble des activités de recherche et la réalisation de Géotechnique de la Géotechnique Réseau écossais universités (SUGN)

A.K. Leung, I.X. Anastasopoulos, C. Augarde, D. Barreto, A.J. Brennan, M.J. Brown, D. Connolly, W. M. Coombs, T. Davies, Z. Gao, A. Ivanovic, M.J. Kenny, J.A. Knappett, D. Lombardi, J. McDougall, G.M. Medero, D. Muir Wood, G. El Mountassir, A.S. Osman, S. Pytharouli, P. Sentenac, B. Stewart, C. Switzer, A. Tarantino, S.J. Wheeler, P.K. Woodward and M. Zielinski

ABSTRACT Design of geotechnical systems is often challenging as it requires the understanding of complex soil behaviour and its influence on field-scale performance of geo-structures. To advance the scientific knowledge and the technological development in geotechnical engineering, a Scottish academic community, named Scottish Universities Geotechnics Network (SUGN), was established in 2001, composing of eight higher education institutions. The network gathers geotechnics researchers, including experimentalists as well as centrifuge, constitutive, and numerical modellers, to generate multiple synergies for building larger collaboration and wider research dissemination in and beyond Scotland. The paper will highlight the research excellence and leading work undertaken in SUGN emphasising some of the contribution to the geotechnical research community and some of the significant research outcomes.

1 INTRODUCTION

The Scottish Universities Geotechnics Network (SUGN), was established in 2001. The major vision of the network is to create synergies in geotechnical research, aiming to build larger collaboration and wider research dissemination in and beyond Scotland. SUGN currently has 27 members from Universities of Aberdeen (UoA), Dundee (UoD), Durham (DU), Edinburgh (UoE), Glasgow (UoG), Heriot-Watt (HWU), Napier (NU) and Strathclyde (UoS). The members have diversified with cross-disciplinary research portfolios, which converge to the common goal of tackling sophisticated engineering problems. The paper highlights the research excellence and leading work currently undertaken in SUGN.

2 FUNDAMENTAL SOIL BEHAVIOUR

2.1 Novel development of experimental techniques

SUGN members have a strong interest in characterising the fundamental soil behaviour through experimental techniques. Special attention is paid to unsaturated soil, especially from the groups in UoG and UoS. Improved understanding can aid the design of foundations; climatic effects on embankments; and behaviour of clay barriers for underground disposal of nuclear waste. The UoG group has a wide range of specialised laboratory facilities for testing hydromechanical soil behaviour, including multiple sets of suction-controlled triaxial apparatus. Currently, a number of member universities (UoD, UoG, UoS and HWU) have a common interest to study thermo-hydromechanical behaviour of soils (Haghighi et al. 2012). An example is a joint project recently established between UoD and UoG, co-funded by *Energy Technology Partnership* and *Transport Scotland*. The project investigates the potential use of energy piles as a heat exchanger to promote the development of soil suction that would help enhance the stability of soil slopes.

There is also an increasing focus to study the microstructure of unsaturated soils when subjected to mechanical and hydraulic loadings. Members from HWU and UoS use an Environmental Scanning Electron Microscope and Mercury Intrusion Porosimetry (El Mountassir et al. 2014) for microstructure analysis. This approach has broad applicability in explaining macro-scale behaviour. For example, observed evolution of soil microstructure could be used as a tool to specify appropriate compaction conditions for earthworks where fill material is susceptible to volumetric collapse (El Mountassir et al. 2014). The School at DU houses X-ray computed tomography (XRCT) scanning facilities for visualising soil microstructural evolution (Fig. 1). This facility has proved revealing in improving understanding of soil-based construction materials and finding a link between intrinsic macro-properties and microstructural features.

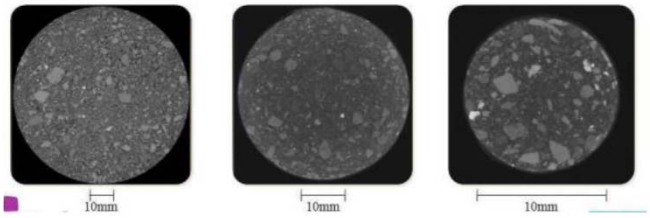

Figure 1. XRCT scans of cylindrical rammed earth samples of different diameters (100, 38 and 12 mm) showing microstructure at different scales (Smith and Augarde 2014)

Mechanical behaviour of degradable soils is studied by the members from NU. They have developed an innovative hydro-bio-mechanical model for capturing its behaviour. Volumetric change and shearing resistance in granular mixtures at a range of particle sizes have been investigated in small-scale mixtures. Particle loss leads to an increase in void ratio with associated changes in behaviour - from dilative in the intact state to more contractive following particle loss (Fig. 2; McDougall et al. 2013). Associated grading changes have been interpreted using concepts of grading entropy, by which means frequency distributions can be depicted as data points thereby providing a useful means of tracking grading changes. This work has recently found added relevance in the analysis of landfill, reclaimed and treated soils that retain a proportion of organic content.

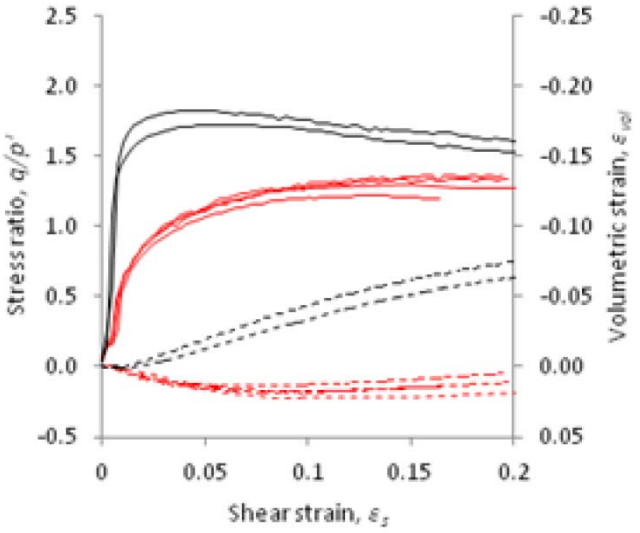

Figure 2. Stress-ratio and volumetric strain (dashed) responses for sand-salt and post-dissolution tests, 1.0 mm salt, 15% by weight

Testing the evolution of fabric anisotropy during straining and the effect of this on mechanical behaviour is one of the major focuses of the members from UoG. This can be of considerable practical importance for construction of embankments on soft clays or problems of sand liquefaction. The research has led to the development of constitutive models incorporating anisotropy evolution for both soft clays and sands (Gao et al. 2014).

2.2 Constitutive and numerical modelling

The UoG team has made important contributions in the development of improved constitutive models for unsaturated soils, perhaps most significantly a coupled mechanical and water retention model (Wheeler et. al. 2003). This model is based upon improved understanding of the physical processes occurring at the inter-particle and inter-aggregate level, with the result that it is able to better predict both mechanical and retention behaviour, and their complex coupling, for the full range of possible stress paths. Lloret-Cabot et al. (2014) showed that the model predicts well the variations of both void ratio and degree of saturation of a soil that involved large magnitudes of compression during successive stages of drying, isotropic loading and wetting.

Other SUGN members have also developed several novel computational techniques. The group in DU implemented various efficient and accurate methods for nonlinear continuum modelling and fracture, including finite element (FE) and meshless techniques. The team has also worked on Material Point Method (MPM), an exciting mix of meshless and FE methods which can capture very large deformation events as often found in geomechanics. This new method is currently being applied in a collaborative project with UoD on offshore soil ploughing. Another contribution made by the DU team is the development of an improved approach to study the cone penetration test and evaluate the effect of strain softening on the penetrating resistance (Osman and Randolph 2014). In this approach, the strain components are treated as field variables. The global solution is obtained using the streamline upwind Petrov–Galerkin method, together with an Eulerian-based FE formulation.

An advanced technique, Discrete Element Method (DEM), is used by the group in NU to study the failure of granular materials under three-dimensional stress conditions, while considering the influence of the intermediate stress ratio (Barreto and O'Sullivan 2012). DEM has aided the quantification of fabric and void anisotropy to identify the particle scale interactions. DEM is being used to explore the significance of real particle characteristics and particle-size distribution on the simulation of cemented soils, such as shales. This method has also been used to study the behaviour of dissolving soils and responses of piles under dynamic loads.

3 FIELD MONITORING TECHNIQUES

The research teams in DU and UoS have a common interest in developing local sensors for the purpose of long-term monitoring of suction (e.g. high capacity tensiometers) and water content in the laboratory and field. In addition, members from UoS focus on the implementation of non-invasive methods that enable enhanced understanding of the subsurface. A microseismicity technique has been developed for detecting the location and orientation of rock fracture planes at depth. The validity of Electrical Resistivity Tomography (ERT; Fig. 3) for accurate detection of desiccation cracks in flood embankments was demonstrated in a series of miniature and field-scale studies (Jones et al. 2014).

4 ENGINEERING APPLICATIONS

In addition to fundamental research, SUGN members have also had a diversified research portfolio to evaluate the engineering performance, and hence improve the design, of various types of critical geotechnical infrastructure. Within the network, a number of successful collaborative projects have been established.

4.1 Offshore engineering

4.1.1 Cable ploughing and installation processes

The members, DU and UoD, have recently awarded a joint research project looking at the use of MPM to model seabed ploughing for infrastructure installation. Soil ploughing, an activity carried out by man for thousands of years for agriculture, is now used at a much larger scale on the seabed to connect offshore energy generation devices to the supply network (Lauder et al 2013). However, there is a lack of understanding of the mechanical and hydraulic processes associated with soil ploughing. In this project, MPM will be applied to simulate seabed ploughing to provide better estimates of key parameters such as tow force and ploughing speed in a given seabed deposit along with insights into plough stability. Given the likely ploughing activity in the next 20-50 years in UK waters, this new predictive approach could result in major savings for the industry.

Figure 3. ERT monitoring along the crest of a flood embankment

Another active collaborative project being carried out by the members of UoD and UoA is the study of the critical specific gravity (SG) for cables and umbilicals during various backfilling and installation processes. Seabed conditions, wave action and tidal effects, coupled with ship movement/anchoring and fishing activity may cause a threat to submarine product (i.e., cables/umbilicals). One solution to reduce the risk is to bury products below the seabed through ploughing and backfill. For a cost-effective design, reducing the SG of products has obvious cost savings, but the drawback is that buoyancy effects may result in product movement or de-burial. The project aim is to develop a greater understanding of the controls on the product behaviour during burial. The outcome will be to develop guidance on the most appropriate burial techniques. This will be further extended to look at min. burial depths and the effects of co-burial using the 1-g soil bed tank available at UoD.

4.1.2 Ground anchor systems and trawling

Dynamic behaviour of ground anchorage systems is studied by UoA, through numerical modelling along with complementary laboratory tests of anchorages installed in rock and soil (Palop et al. 2013). The interface between the bearing plate of an anchor and the concrete surface has been shown to be the main element in determining the pre-stress load of the anchorage. Testing of the interface between the grout and the steel bar has also been undertaken using experimental tests and contact mechanics. The findings have been used to develop a non-destructive testing method GRANIT which is currently used commercially.

Another interesting topic that the member from UoA is investigating is the impact of trawling on the benthos ecosystem (seabed). Towed demersal fishing gear is used globally by the fishing industry to catch species that live on or close to the seabed. To understand these processes and to be able to assess their wider implications on the benthic ecosystem, it is essential to understand the physical interaction of the individual gear components with the seabed. The

impact of a cylindrical clump weight and an otter trawl door on a cohesive soil was developed by Ivanovic et al. (2011), who validated their approach by comparing the results from experimental sea trials with model predictions. Both studies use the FE Abaqus software package where Arbitrary Lagrangian-Eulerian mixed formulation was used. This study has been extended to investigate how the dimensions, the weight, the cross sectional geometry and the soil material properties affect the drag force and the penetration into the seabed of cylindrical clumps. The study of ground gear elements using Combined Eulerian and Lagrangian methods has been undertaken and the results between the laboratory and numerical studies are very encouraging to be potentially used in further studies (Esmaeili and Ivanovic 2014).

4.1.3 Foundation engineering

The teams of UoD and UoA have a joint project investigating enhanced gravity foundations on rock for marine energy generators. This project focuses on an alternative design of the foundation as a gravity base where resistance is provided by its self-weight and the interface friction between seabed and the foundation. Very little work has been done to assess the interface friction between steel foundations and rock. The project aims to develop a greater understanding of the material controls on the foundation interface behaviour. The outcome will be to develop a database of rock/ foundation interface properties and improved design procedures that will lead to less conservative design and improved financial viability of marine energy generators (See paper by Ziogos et al in the proceedings).

Members from NU, focus on another type of foundation. They study the dynamic behaviour of pile-supported structures under different types of cyclic loading such as earthquakes, wind and wave loading. It is recognised that the foundation behaviour depends on complex soil-structure interaction and nonlinear soil response. In addition, in the presence of saturated loose to medium dense sandy soils, excess pore pressure generated by loading cycles may induce significant soil softening which, in extreme cases, may lead to liquefaction phenomena. Current research in NU is investigating the effects of wave-induced liquefaction on the behaviour of offshore wind turbines supported on different types of foundations (monopile, suction caisson, jacket foundations), by means of a combination of small-scale physical modelling and full-scale numerical modelling (Lombardi et al. 2013).

4.2 Earthquake geotechnics

Within SUGN, UoD is the only member university that possesses a geotechnical centrifuge facility (3.5 m radius, 150 g-ton capacity) mounted with the stateof-the-art earthquake simulator. This facility is unique in Scotland and is only one of three in Europe. Compared with 1-g physical model tests, centrifuge tests at elevated gravitational acceleration levels correctly model the stress levels of a much larger prototype. By using this facility, the group has made significant and important contributions in earthquake engineering. One example is a recent study of the engineering performance of rocking-isolation inelastic reinforced concrete (RC) bridge piers (Loli et al. 2014). In this study, a novel scale model RC (1:50 scale; Knappett et al. 2011) that simulates reasonably well the elastic response and the failure of prototype RC members is utilised to model a bridge pier (Fig. 4). A variety of seismic ground motions are considered as excitations. They result in consistent demonstrably beneficial performance of the rocking-isolated pier. Foundation uplifting has a self-centering potential, whereas soil yielding is shown to provide an effective energy dissipation mechanism, exhibiting significant resistance to cumulative damage. Thanks to such mechanisms, the rocking pier survived, with no signs of structural distress, a deleterious sequence of seismic motions that caused collapse of a conventionally designed pier.

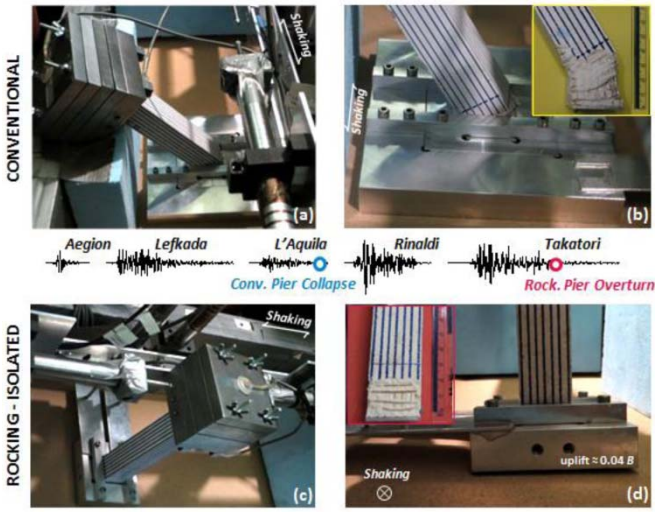

Figure 4. Photos of bridge models (a) the conventional pier having failed after shaking and (b) closer view of its column base and foundation; (c) the rocking pier after shaking plus two additional strong motions and (d) its foundation (Loli et al. 2014).

Members from UoD currently have a wide spectrum of research utilising this facility. This includes the seismic performance of other soil–structure systems such as piled foundations, retaining systems, and underground structures and also development of novel foundations and offshore anchoring solutions.

4.3 Railway engineering

Members from HWU are dedicated to research in railway engineering. Railway track settlement has considerable cost and time implications to the rail industry through maintenance operations, track reconstruction and line speed restrictions. Settlement occurs in both the soil and substructure, and it is important that it is monitored before differential track settlements give rise to faults (Woodward et al. 2014). Therefore, to model the railway track settlement process, HWU has developed the unique Geo-pavement and Railways Accelerated Fatigue Testing facility (GRAFT; Fig. 5) that enables accelerated, full-scale testing of existing and new railway products under realistic railway conditions. It is the largest of its kind in the UK and has a hydraulic capacity of 200 tonnes. Thus it enables the performance of new settlement solutions and new track-forms to be quantified and compared with confidence. In parallel, the team at HWU has been working on modelling to fully understand the train-induced vibration at different conditions of interest (El Kacimi et al. 2013).

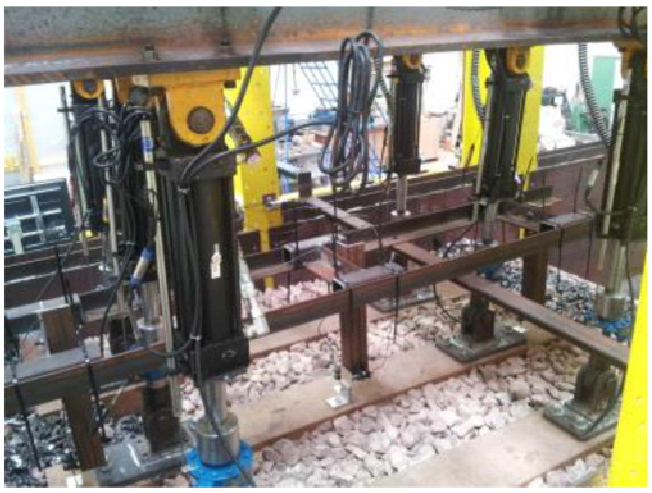

Figure 5. GRAFT facility at HWU

5 CROSS-DISCIPLINARY TOPICS

Various types of cross-disciplinary research are developed within SUGN. This includes the teams of UoS and DU, who focus on contaminant fate in unsaturated soil and remediation. The UoS team has a particular interest in studying the potential use of microbial processes to alter the behaviour of porous media and fractured rock. The team has investigated microbially induced calcite precipitation for sealing rock fractures. This represents a means of controlling the gel time of low viscosity grout for injection into fractured rock (MacLachlan et al. 2013), which is a new avenue of research in geotechnical engineering.

Members from UoD have a strong interest in developing the use of plant roots as a green stabilisation technique for enhancing the sustainability and resilience of earthwork infrastructure against environmental loadings including rainfall and earthquake. They are currently quantifying the mechanical root reinforcement (both in failure strength and pre-failure deformation), and strength enhancement due to transpiration-induced suction (Ng et al. 2014).

6 FINAL REMARKS

This paper presents a wide range of interesting and challenging research topics within SUGN. This covers the characterisation and modelling of soil behaviour and multiple engineering applications. Mutual synergies created by SUGN have made significant contributions to the geotechnical research community and industry, providing useful insights into better understanding of complex soil behaviour and improved design of geotechnical systems. However, there are still many scientific questions yet to be answered. Some of them are cross-disciplinary, which would potentially break out of old subject straitjackets, forming new research links that may themselves lead to other unusual future research themes.

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The construction of a 12m high embankment over weak soils in St Petersburg, Russia, utilizing the use of a cellular foundation mattress system

La construction d'un haut remblai de 12m sur des sols faibles à Saint-Pétersbourg, en Russie, en utilisant l'utilisation d'un système de matelas de base cellulaire

Anna Kuznetsova and Chaido Doulala-Rigby

ABSTRACT A major new highway, Saint-Petersburg Ring Road, was planned to be constructed in St Petersburg, Russia. The project was awarded to the successful Contractor who, based on the available contract documents, priced for a simple 12m embankment construction over competent foundation soils. Soon after the Contractor moved on site, it was realized that the foundation soils were far from competent. Additional investigation revealed deep layers of weak clayey soils, exhibiting bearing capacities far less than the required ones to support the proposed embankment. The Contractor had to adopt a cost effective and fast to construct foundation strengthening solution in order to meet the stringent project budget and the tight construction deadline, worsened by the unprecedented required additional major foundation improvement works. The strengthening solutions considered included a piled foundation to support the embankment, lightweight fill on top of the existing poor foundations, a piled flyover instead of a soil embankment and basal reinforcement with a high strength geotextile. All options were rejected due to their high cost and/or difficulty in construction due to the extreme poor nature of the foundation soils. The final adopted solution was a robust, flexurally stiff cellular foundation mattress, called Tensar Stratum TM comprising 1m high vertically placed uniaxial geogrids forming cells filled with granular fill, forming not only a stable temporary works platform for construction plant to gain access over such weak subgrades but finally providing a sound foundation layer to support the proposed 12m high soil embankments on top in the long term.

1 SAINT-PETERSBURG RING ROAD (KAD)

The need of a Ring Road around Leningrad (former name of St. Petersburg during Soviet Union period) was observed in 1965 but the lack of financing caused a delay up to 1998. The last section of the project, which forms a causeway across the Gulf of Finland, opened in 2011. Today this road is connecting all main transport corridors from the Northern -West Region to Helsinki, Moscow, Kiev and Tallinn.

The total length of the road is 142 km and it includes 1 tunnel and 105 bridges and viaducts.

As St. Petersburg is located in a treeless Neva lowland laid with lacustrine-glacial deposits, local soils often have a high water level, inclusions of peat or silt and low bearing capacity. Lots of various soil improvement techniques were used during KAD construction. A geogrid cellular foundation mattress - was recognized as one of the most effective methods.

2 LOT N4 CONSTRUCTION

Lot N4 of the eastern half of the ring road went under construction in 2005. It included a flyover at the intersection with Oktyabrskaya Railway line to station Mga. To provide an extensive elevation over the rolling stock an approach embankment of 11.6m high was proposed. The initial Soil Investigation Report for this section indicated natural ground that was described as competent so no additional measures for overall stability and bearing capacity were designed. The contractor started with the construction of the piled foundation for the reinforced concrete abutment. It was soon realized that what was described as 'competent' in the initial Soil Investigation, was a dried streambed forming just a 'crust' crossing the site. The 'crust' was actually found to be underlaid by 23m of soft soil deposits with ground water level at -0.5m below the surface (Figure 1) that was covered with topsoil.

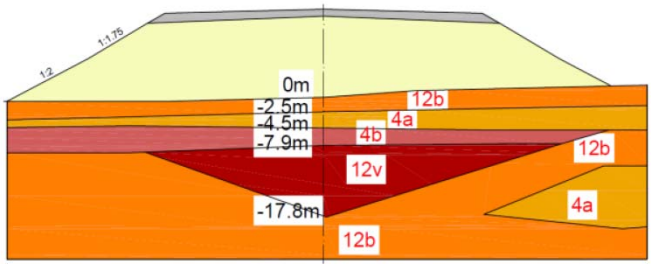

Figure 1. CH701+64 section

The encountered soft soil deposits comprised sandy and silty clays with low strength properties (Table 1) and squeezed between the fingers under compression (Figure 2).

Table 1. Design soil strength parameters.

Soil	Description	Angle of friction , ϕ'°	Cohesion c', kPa	E_0 modulus, MPa
4a	Fluid thixotropic silty clay	13	6	6.5
4b	Fluid thixotropic streaky silty clay	7	7	3.8
12b	Plastic sandy clay	19	16	11
12v	Fluid sandy clay	7	5	8

Figure 2. Typical soft soils on the site

Overall stability FoS against bearing failure was <0.9, the predicted settlement was in the order of 0.64m and 1.79 years would be required until 90% of the predicted consolidation took place.

2.1 Comparing alternatives

According to the contract there were only 10% from overall construction costs allowed to be spent to deal with unforeseen site conditions. Consultant company NTO OOO "Dorservice" provided an independent comparison of several soil improvement techniques in order to identify the most cost-effective one (Table 2).

Together with several conventional methods, Tensar Stratum™ cellular foundation mattress, which can be installed directly on the natural soil in the base of embankment, was

offered. This cellular foundation mattress system is 1 m thick and forms a continuous series of interlocking cells using stiff polymer uniaxial and triaxial geogrid reinforcement to contain and confine granular material, providing a stiff but permeable foundation to an embankment that maximises the bearing capacity of the soft soil beneath it (Bush et al., 1989) and forms a stable base for the embankment. It is worthy to note that unlike the conventional constructions with high strength reinforcement geotextiles which required provision of anchorage length, the geogrid cellular foundation mattress option is self-contained and does not need extensive external anchorage beyond the embankment base.

Table 2. Soil improvement options comparison

N	Option	Cost (k$)
1	Cement-sand piles	15790
2	Drilled piles	17877
3	Driven piles	19443
4	Lightweight embankment with expanded polystyrene	8563
5	Bridge	9362
6	Embankment with geodrains	3051
7	High strength geotextile reinforcement	5579
8	Tensar Stratum™ reinforced mattress	2525

According to the comparison as presented in Table 2 above, the cheapest type of piled foundation was 6.25 times more expensive than the geogrid cellular foundation mattress High strength geotextile reinforcement, being the most traditional and usual practice, was originally expected to be the most effective. However, since this technique does not reduce the value and period of settlement, the cost of the predicted asphalt repairs of the finished pavement supported by the embankment had to be added to the total cost making a geotextile option expensive. Amongst all soil improvement options considered, The geogrid cellular foundation mattress was found to provide faster soil consolidation and even and reduced settlement across and along the embankment. The geogrid cellular foundation mattress was chosen as the most appropriate improvement option and was adopted for the scheme.

2.2 Geogrid cellular foundation mattress Design Concept

The application of a geogrid cellular foundation mattress under the base of an embankment over a soft soil will create an embankment foundation with the following features (Jenner et al., 1988):

(a) A perfectly rough interface between the mattress and the soft foundation soil due to the partial penetration of the granular fill through the base geogrid material. A unique multi-directional geogrid with triangular shaped apertures was adopted as the base for the geogrid cellular foundation mattress in this project.

(b) A stiff platform to ensure both an even distribution of load onto the foundation and the formation of a regular stress field within the soft foundation soil. The stiff platform is created by the high tensile strength of the uniaxial geogrid material used in the geogrid cellular foundation mattress construction to confine the granular infill.

The above characteristics have the effect of rotating the principle stresses and hence potential slip planes through the geogrid cellular foundation mattress depth so that the potential slip plane is near vertical at the interface between the mattress and the soft foundation soil. Any potential slip circles are thus driven deep into the foundation soil and the plasticity bearing condition becomes a more critical mode for design rather than a slip circle. Therefore, an enhanced bearing capacity can be developed with a full base friction situation (i.e., perfectly rough base) being the ultimate achieved value.

The stress condition at the interface between the geocell mattress and the soft soil is then examined to ensure (BS8006-1:2010) that the confining stress available from the stiff geogrids acting on the granular fill is greater than the required to mobilise the full shear strength of the underlying soft soil. The method of evaluating the horizontal stress at the interface is carried out using the Mohr circle construction considering the friction angle of the granular fill and the limiting shear stress (i.e., the undrained shear strength) of the soft soil layer.

2.3 Geogrid cellular foundation mattress construction

The contractor had no previous experience in constructing this type of structure and expected the process to be time and labor consuming. A subcontractor was hired to construct the geogrid cellular foundation mattress under the guidance of the manufacturer (Tensar).

The average construction rate for a team of six workers was approximately 200sq.m per shift. The site team managed to complete the total 5000 sq.m of geogrid cellular foundation mattress installation and filling in just less than 1 month. Figures 3 and 4 show views during the geogrid cellular foundation mattress construction.

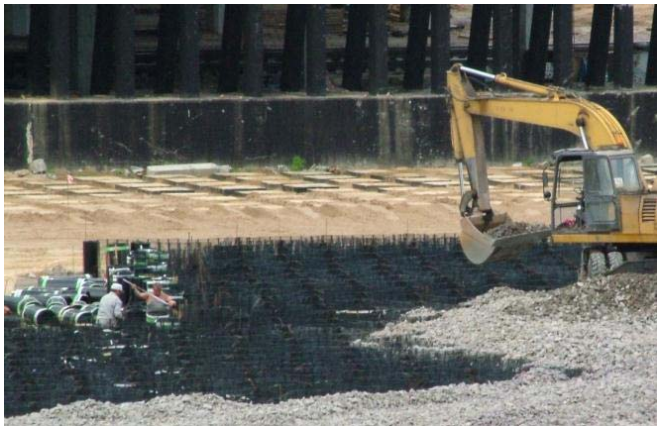

Figure 3. Raising and filling the geogrid cellular foundation mattress.

Figure 4. Geogrid cellular foundation mattress general view.

2.4 Further construction monitoring

For projects that involve high loads on soft soil construction monitoring is always recommended. In this project, 6 pore pressure transmitters (piezometers) and 6 settlement markers were installed on 25/7/2005 and 5/8/2005 though

boreholes 120mm in diameter and below/at the base of the geogrid cellular foundation mattress (Fig 5). Monitoring was carried out until December 2005.

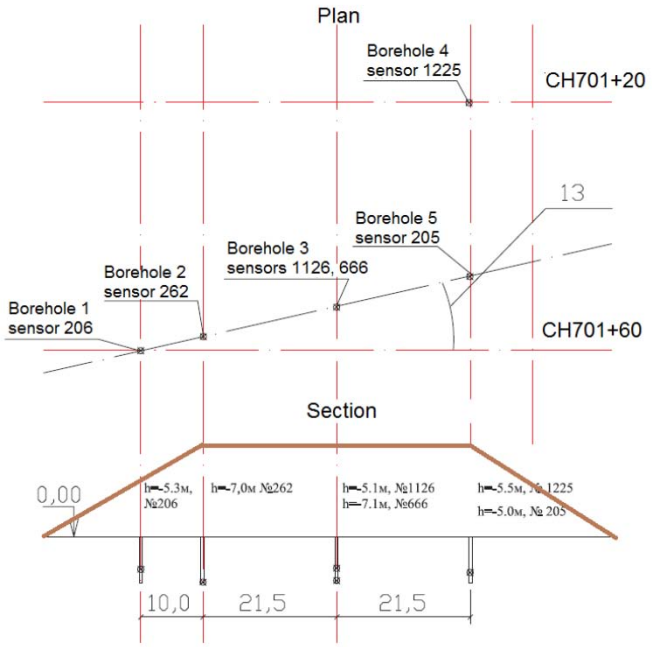

Figure 5. Monitoring instrumentation location.

Graphics of pore pressure level in relationship with the applied load during construction period were developed to control the speed of embankment construction. Filtration consolidation started when pore pressure reached a value of 0.132 MPa (Figure 6).

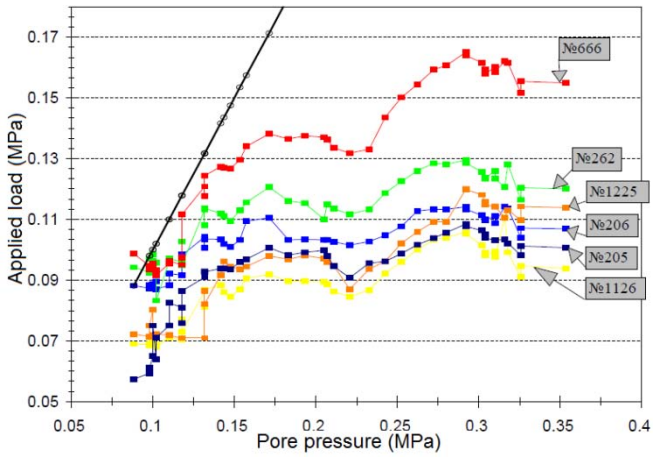

Figure 6. Consolidation pressure determination.

The ratio of pore pressure to applied load was also plotted against time (Figure 7). If the 25/7/2005 (piezometer installation date) is taken as day 0 then by day 100 approximately, that would correspond to November 2005, it was measured that ~30% of the applied load was carried by water and ~70% of applied load was carried by the consolidated foundation soil. Monitoring also revealed that by November 2005, 90% of the predicted settlement was reached (Figure 9).

One of the main reasons for pore pressure control is the limitations of soil lateral movement. This value has to be high enough to facilitate filtration, but at the same time to prevent soil particles from horizontal shearing. It is therefore vital that the filling process of both the geogrid cellular foundation mattress and the embankment above is controlled and monitored so that the system is always kept in equilibrium.

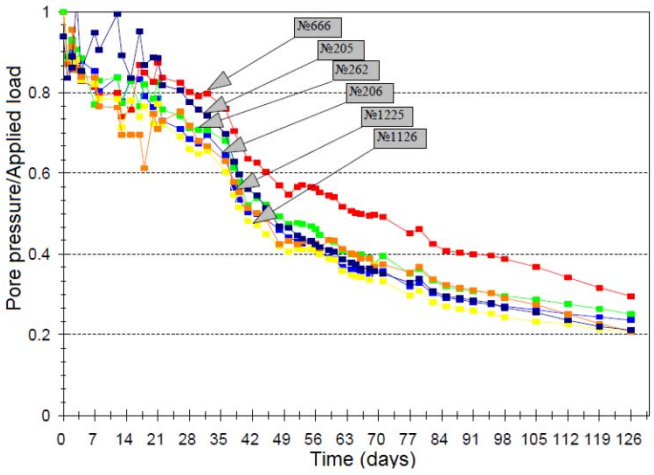

Figure 7. Pore pressure to applied load ratio reduction with time.

At the end of August 2005 and beginning of October 2005 (Figure 8) the construction process had to slow down to avoid foundation plastic failure. This did not affect the construction program as construction activity was moved to adjacent section so no real construction time was wasted.

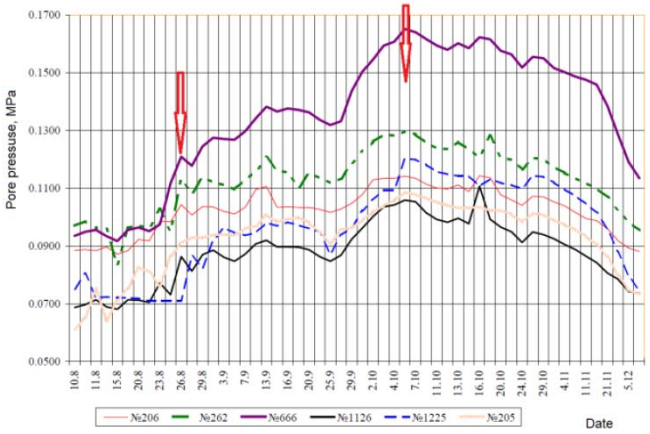

Figure 8. Pore pressure measurements showing August 2005 and October 2005 peaks.

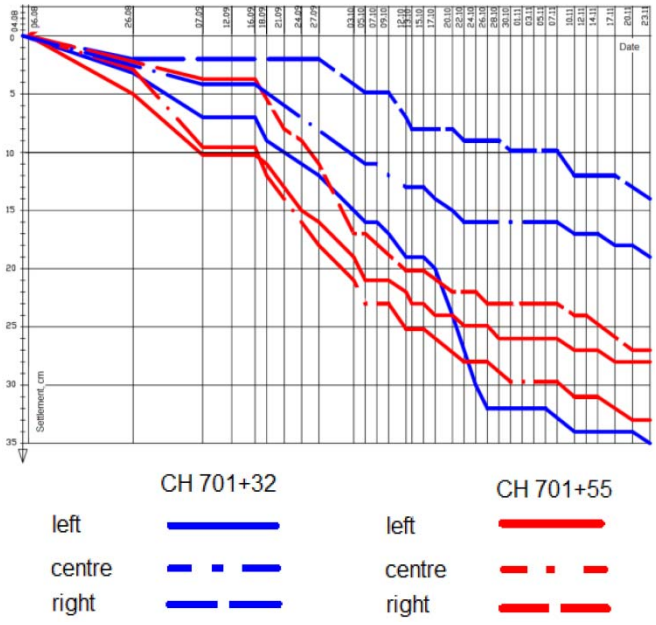

Figure 9. Settlement measurement.

Finally the embankment was complete on time and consolidation settlement ratio was limited within 2cm/year, which is an allowable rate for pavement construction.

3 RESULTS

The geogrid cellular foundation mattress successfully allowed for:

- stability of the foundation without the need for expensive and time consuming options
- safe access to site and a proper working platform for construction machinery
- even and controlled settlement

Maximum total settlement was 34cm, which is just 54% of the predicted value. 90% of consolidation was reached in only 4 months because the geogrid cellular foundation mattress due to its permeable nature, serves as a good drainage layer too at the base of embankment. The contractor successfully met the completion date deadline on time and within budget.

To date, no pavement repair has been necessary due to secondary settlement and this project became a good gateway for many more geogrid cellular foundation mattresses to be successfully constructed in the following 9 years.

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Bridge Approach Embankment with MSE Walls and Pulverized Fuel Ash

Chaido (Yuli) Doulala-Rigby and Martin Black

For a new major road construction (the Tinsley Link) in the North of England, a bridge approach embankment needed to be designed and constructed. A 500m-long mechanically stabilized earth (MSE) wall on piled foundations was proposed, one that would utilize geogrid reinforcement and enable the beneficial use of pulverized fuel ash (PFA).

The PFA—a waste product of pulverized fuel (typically coal) fired power stations—was supplied by the nearby EDF West Burton and Cottam power stations. The MSE walls were built up to 11m in height in order to achieve the required grade separation of the proposed link road alignment.

The project provides an exemplary case of geogrid design and construction.

REINFORCING TINSLEY LINK

Tinsley Link forms a key part of a government approved £28 million strategic Bus Rapid Transit (BRT) scheme in the North of England that aims to help unlock economic development in the Lower Don Valley by funding a high frequency bus service from Rotherham to Sheffield.

Sheffield City Council looked at various options of structures that could form Tinsley Link. The options included a continuous raised viaduct on piled piers, an embankment with piled reinforced concrete walls, and construction over a reinforced soil embankment. The geogrid-reinforced MSE option was selected due to advantages in cost, construction time, sustainability, and environmental friendliness.

The main role of geosynthetics in the work concern the construction of a bridge over existing rail tracks and the adjacent River Don—a section known as the Fitzwilliam Bridge—and the design and build of approximately 490m-long reinforced soil approach embankments to the bridge on a piled foundation.

PULVERIZED FUEL ASH FOR FILL

The existing founding soils were comprised of low-bearing foundation strata that would be unable to support the proposed reinforced soil embankments. The most cost-effective method of ground improvement was deemed to be a combination of Vibro Stone Columns (VSCs) under the lower parts of the wall and concrete piles under the higher parts of the wall. A geosynthetic-reinforced granular load transfer platform (LTP) on top would form the founding medium for the proposed reinforced soil embankment.

The reinforced fill needed to impose the lowest self-weight on the foundations. Three options were considered:

- Well-graded granular fill with maximum particle size of 125mm (such as type 6I/6J as per Series 600 of Highways Works Specification in the UK)
- Selected wet/stony cohesive fill ((such as type 7C/7D as per Series 600 of Highways Works Specification in the UK)
- Pulverized Fuel Ash (PFA)

PFA was selected due its low density, when compared to natural granular or cohesive fills. The supply came from coal-fired power stations located approximately 40 miles from the site.

Today, pulverized fuel ash is used widely as engineering fill and as a component for concrete. PFA normally undergoes a pozzolanic reaction and cements over time. When newly produced PFA is strongly alkaline; a pH as high as 11 is known, and >9 is normal but it does often decline in time towards the average value of 7. This high alkalinity excludes some materials (e.g., steel, polyester) from being used to reinforce PFA. This problem does not arise with high-density polyethylene uniaxial geogrids, as they are inert to chemical attach and are unaffected by high pH conditions.

Soil Type	ϕ' (°)	c' (kPa)	γ (kN/m³)
PFA Fill*[1]	27	5	15.5
Improved Foundation Soils (Basal Reinforcement/LTP by others) *[2]	30	0	20

*[1]Based on laboratory test data provided by the Contractor

*[2]Based on basal reinforcement/load transfer platform (LTP) composed of granular material.

Design parameters for pulverized fuel ash and foundation soils

TWO MSE SYSTEMS

Two types of MSE systems were used:

- Concrete modular face walls with PFA reinforced fill
- Steel mesh panel face thrust relief walls with PFA reinforced fill

The concrete modular face walls comprise four major components: concrete modular face block, HDPE uniaxial geogrid, polymeric mechanical block connector, and the reinforced pulverized fuel ash fill.

An added advantage of the modular block retaining system was that the individual component parts of the system could be easily transported to the site separately. In addition to that, the individual components are all dry laid so no curing time or formwork is necessary, saving precious time in the construction program.

The steel mesh panel face walls were comprised of uniaxial geogrid to reinforce the soil, steel mesh panel to provide retention to the slope face (also acting as formwork), and a layer of erosion control geotextiles, which provided a barrier to the vertical drainage layer that was placed in front of the reinforced fill.

MSE CONSTRUCTION

Construction with geogrid-reinforced retaining modular block or steel facing walls is a relatively straightforward procedure with all components dry laid, in accordance to a well-established and a tried and tested construction sequence. The pulverized fuel ash was compacted and reinforced with uniaxial geogrids.

The Tensar geogrid used on the project is characterized by long, slim apertures. In the manufacturing process, the high-density polyethylene grid is stretched in one direction to produce a geogrid with significantly higher strength in the direction of roll than in the cross direction. The geogrids are secured to the modular block facing by the polymer mechanical connector or through the steel mesh panel face secured with a horizontal steel rebar. The 200 mm wide, 200 mm deep, 400 mm long modular concrete blocks are laid dry without using mortar, removing the need for any water-based products to be used in the process. The grids are laid with the apertures perpendicular to the wall face blocks and slightly tensioned to remove any slack. PFA fill is then placed and compacted to 200 mm thickness, typically

to 95% of its dry density. The geogrid is laid inbetween the compacted PFA fill layers at a vertical spacing typically varying from 200 mm to 600 mm.

Geogrids being slightly tensioned to remove slack during installation

For Tinsley Link a few extra construction measures had to be implemented in order to facilitate the successful installation of the PFA fill. PFA is susceptible to scour and washout. Additional drainage measures were made as outlined in BS8006-Part 1:2010 Cl. 6.10.5.2, Cl. 6.10.5.3, and Cl. 6.10.2.6.3. The whole PFA reinforced soil block was encased in drainage layers as follows:

- A 200mm thick drainage layer was placed over the entire base of all reinforced soil walls directly above the LTP.
- A vertical 300mm thick drainage sand layer of grading C or M (as defined in BS882) was placed directly behind the modular concrete blocks.
- A vertical 1000mm thick drainage sand layer of grading C or M (as defined in BS882) was placed directly behind the steel mesh facing thrust relief walls o behind both the bridge abutments.
- A 500mm well graded granular fill was placed at the crest of the reinforced soil walls below the finished pavement construction.

All drainage layers were constructed with adequate drainage pipes that were integrated and discharged off appropriately to the wider site drainage system.

Movement joints 20mm wide filled with compressible silicon joint sealant were constructed along the embankment where the foundation type changed from VSCs to PRIs and at the interface between the edge of the bridge abutment pile cap and the abutted remaining MSE walls.

A minimum 200mm void was allowed for in between the face of the steel mesh facing thrust relief wall and the bridge abutment to allow for any potential deformations of the TR2 face during its construction and to ensure that there will be no load transfer from the thrust relief wall onto the bridge abutment. This void can be filled with compressible material such as pea gravel or polystyrene blocks.

A number of sustainable urban drainage system (SUDS) drainage culverts, typically 600mm in diameter and animal passage tunnels were incorporated at set locations throughout the base of the embankment. Detailed geogrid arrangements were provided where the culverts and tunnels were interfering with the geogrids ensuring the stability of the MSE walls remained intact.

Animal passage tunnel along the base of the MSE wall

A SUSTAINABLE, AFFORDABLE SOLUTION

In the end, the savings of replacing the granular fill with pulverized fueld ash were in the order of tens of thousands of pounds. The benefit of using waste/marginal fill in the current economic and environmentally sensitive times was easy to demonstrate, thereby maximizing the role of geosynthetics in providing engineering solutions that are not only sustainable and environmental friendly but, above all, are structurally sound, aesthetically attractive, fast to construct, cost effective, and maintenance free.

Chaido (Yuli) Doulala-Rigby is Chief Civil Engineer with Tensar International Limited, United Kingdom. Martin Black is a Project Manager for Carillion Plc, United Kingdom.

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A full version of this article was published in the GeoAmericas 2016 Proceedings*. The April 2016 conference was hosted by the* International Geosynthetics Society North American Chapter*. Learn more about the event and acquire a copy of the three-volume digital proceedings at* www.geoamericas2016.org*.*

(Chris Kelsey / geosynthetica.net, November 13, 2016, http://www.geosynthetica.net/fuel-ash-fill-mse-embankment-tensar)

Project Video: Geosynthetic Tubes for Coastal Protection

A new project video from Huesker details a 1500m-long coastal protection installation of geosynthetic tubes along Lake Sedlitz in Germany's Lusatian Lake District. The 1400 ha (3460 acre) lake is the largest of the manmade lakes in the former lignite mining area. The old mines have been flooded, a process that has restored the region to its historical natural beauty.

As the waters of Lake Sedlitz were given their final raising, which would bring them up to the Village of Lieske, geosynthetic erosion control and coastal protection tubes were used to give the shoreline long-term stability.

SoilTain® Coastal Protection Tubes from HUESKER were selected.

Coastal Protection Cliff Lieske | SoilTain Coastal Protection Tubes https://www.youtube.com/watch?v=XnoJ6BMy_tw

COASTAL PROTECTION FOR LIESKE

On-going erosion in the area had carved out a 5m-high slope, which led up to the new waterfront. German mining interests, which are responsible for the reclamation of the area, needed to halt erosion and prevent future slippage of the slope.

The installation of the geosynthetic tubes gave the project continuous protection along the entire remediated stretch, and the project demonstrated how inland lakes and ocean-front beaches succeed with the same, efficient coastal protection strategy.

The SoilTain® tubes offered a highly durable, more sustainable solution, as the tubes utilized local soils for their fill. Each tube was able to be built to 50 m in length. The stacked design—two tubes high—provided a continuous 4m protection height.

Additional benefits of the design include the ability of microorganisms to colonize on the surface of the large-volume tubes, the sand-colored geotextiles surface of the tubes (for blending into the environment), and the submergence of the system at the final flooding stage for Lake Sedlitz's completion.

FINAL DETAILS, LAKE SEDLITZ PROTECTION

A geosynthetic sandmat was also installed below the system to prevent piping and erosion beneath the large-volume tubes as well as to provide scour protection above and behind the tubes as additional slope fill was conducted.

SoilTain® bags were used to compensate for any height difference or gaps created by the interface of the system elements. Like the large tubes, the convenient bags were filled with on-site material and offer the same, long-term durability.

(Chris Kelsey / geosynthetica.net / November 11, 2016, http://www.geosynthetica.net/coastal-protection-sedlitz-huesker-video)

ΔΙΑΚΡΙΣΕΙΣ ΕΛΛΗΝΩΝ ΓΕΩΤΕΧΝΙΚΩΝ ΜΗΧΑΝΙΚΩΝ

Βράβευση Σπύρου Κωνσταντή από την Qatar Rail

Ο συνάδελφος Σπύρος Κωνσταντής, Πολιτικός Μηχανικός ΕΜΠ, Technical Manager της Qatar Rail στο έργο κατασκευής της Gold Line του ΜΕΤΡΟ της Doha, βραβεύθηκε από την Qatar Rail ως ο καλύτερος manager της εταιρείας για το 2016.

Ο Σπύρος Κωνσταντής εργάζεται στην Qatar Rail από τον Ιανουάριο 2014 ως Technical Manager στο έργο κατασκευής της Gold Line του ΜΕΤΡΟ της Doha.

Η Gold Line(*) αποτελείται από 10 υπόγειους σταθμούς, υπόγεια αμαξοστάσια, φρέατα και περίπου 23km σηράγγων, που διανοίχθηκαν με 6 EPB TBMs, καθώς και από 24 συνδετήριες σήραγγες που διανοίχθηκαν με την μέθοδο ΝΑΤΜ.

Τα καθήκοντά του περιλαμβάνουν, μεταξύ άλλων:

- Διαχείριση και εξέταση τεχνικών λύσεων και προτάσεων value engineering.
- Διαχείριση και εξέταση τροποποιήσεων των μελετών και των συμβατικών και εμπορικών επιπτώσεών τους.
- Διαχείριση των τεχνικών διεπαφών και συντονισμός μεταξύ των Πολιτικών Μηχανικών / Μηχανικών Συστημάτων / Ηλεκτρομηχανολόγων / Αρχιτεκτόνων στις φάσεις μελέτης και κατασκευής του έργου.
- Διαχείριση και συντονισμός του τεχνικού ελέγχου των μελετών.
- Έλεγχος και παροχή τεχνικής κατεύθυνσης σχετικά με θέματα που προκύπτουν από τον έλεγχο των μελετών και των ερευνών.

(*) Η Gold Line κατασκευάζεται από την κοινοπραξια ΑΚΤΩΡ, LARSEN & TOUBRO, YAPI MERKEZI, STFA και AL JABER Engineering. Μελετητές οι εταιρείες ATKINS, ARUP και OTM. Project Management Consultant η κοινοπραξία LOUIS BERGER / EGIS RAIL και Design Verification Engineer (Αεξάρτητος Μηχανικός) η εταιρεία Mott MacDonald.


RAIL الريل
Accomplishing a Vision

Managing Director's Award of Excellence
2016
Award Category: Project Management

Presented to
Spyridon Konstantis
Technical Manager

In recognition for exceptional performance and commitment to deliver the vision and values of Qatar Rail.

Tuesday, 29 November, 2016

Abdulla Abdulaziz Turki Al Subaie
Managing Director
& Chairman of the Executive Committee

ΝΕΑ ΑΠΟ ΕΛΛΗΝΙΚΕΣ ΚΑΙ ΔΙΕΘΝΕΙΣ ΓΕΩΤΕΧΝΙΚΕΣ ΕΝΩΣΕΙΣ

Geoengineer.org Announces the James K. Mitchell Legacy website!

The James K. Mitchell Legacy website is launched to Honor Professor Jim Mitchell

Geoengineer.org, with the support of the Shamsher Prakash Foundation, is pleased to launch the **James K. Mitchell Legacy** website, a resource website devoted to honor Prof. Jim Mitchell and his long-lasting career at the University of California at Berkeley first and subsequently at Virginia Tech. The website is a repository of bio information, publications, photos, related to Jim Mitchell's truly amazing career in the geotechnical profession.

The website also includes testimonials from some of the 75 PhD students as well as several colleagues of his. The website will continue to be updated as more information is provided/donated.

Geoengineer.org also invites anyone who has any resources related to Prof. Mitchell's career, projects to submit it for inclusion on the website as a historical record of this pioneer of the geotechnical profession.

You can visit the site HERE

ΠΡΟΣΕΧΕΙΣ ΓΕΩΤΕΧΝΙΚΕΣ ΕΚΔΗΛΩΣΕΙΣ

Για τις παλαιότερες καταχωρήσεις περισσότερες πληροφορίες μπορούν να αναζητηθούν στα προηγούμενα τεύχη του «περιοδικού» και στις παρατιθέμενες ιστοσελίδες.

TUNNELLING SUMMIT - Pinpointing project opportunities and exploring innovation in tunnelling, 7-8 December 2016, London, U.K., https://tunnelling.newcivilengineer.com

5th International Conference on Forensic Geotechnical Engineering, 8-10 December 2016, Bangalore, Karnataka, India, http://5icfge.com

International Symposium on Submerged Floating Tunnels and Underwater Tunnel Structures (SUFTUS-2016), 16-18 December 2016, Chongqing, China, www.cmct.cn/suftus

MPM 2017 - First international conference on the material point method for Modelling Large Deformation and Soil–Water–Structure Interaction, 10 – 13 January 2017, Delft, The Netherlands, http://mpm2017.eu

International Workshop on "Advances in Multiphysical Testing of Soils and Shales", 18-20 January 2017, Villars, Switzerland, http://atmss.epfl.ch

ICNCGE-2017 International Conference on New Challenges in Geotechncial Engineering, 23 January 2017, Lahore, Pakistan, www.pges-pak.org/home/icncge-2017

2nd "Dams & Seisms" EWG Workshop
Lessons Learned from the Recent Earthquakes in Italy. Qualification of Seismic Dams Analyses and of their Equipments & of Probabilistic Assessment of Seismic Hazard in Europe
February 6-7, 2017, Roma, Italy
giovanni.ruggeri@enel.com

This international symposium is the second annual meeting of the ICOLD European Club Working Group "Dams and Earthquakes".

ITCOLD will invite experts to present and discuss the lessons learn from the 2016 and 2009 earthquakes and EWG participants to Discuss two questions: "How the probabilistic seismic hazard assessment and the dynamic analyses are validated? What are the evidences of flaws or accuracy incurrentpractice?" The deliverable will be presentations given to all th eparticipants.

Dr. Jean-Jacques FRY
Chairman EWG "Dams and Earthquakes"
jean-jacques.fry@edf.fr / (+33) 6 70 70 16 37

Tunnelling Asia' 2017 - Design, Construction and Risk Management in Underground Construction : Issues & Challenges, 9 - 10 February, 2017, Mumbai, India, sunil@cbip.org; cbip@cbip.org; www.cbip.or

International Congress and Exhibition HYDROPOWER CASPIAN AND CENTRAL ASIA, 15-16 February 2017, Tbilisi, Georgia, www.hydropowercongress.com

4th Arabian Tunnelling Conference & 20th Gulf Engineering Forum - Advancing Underground Space, 21-22 February 2017, Dubai, UAE, www.atcita.com

AFRICA 2017 - Water Storage and Hydropower Development for Africa, 14-16 March 2017, Marrakech, Morocco, www.hydropower-dams.com/AFRICA-2017.php?c_id=89

3rd Annual Urban Underground Space & Tunnelling, 27th-29th March 2017, Singapore, http://isocarp.org/events/3rd-annual-urban-underground-space-tunneling

Instrumentation and Monitoring Conference 2017 - Innovation, best practice and projects, 29- 30 March 2017 | Inmarsat, London, U.K., https://monitoring.geplus.co.uk

2nd International Conference on Geotechnical Research and Engineering (ICGRE'17), April 3 - 4, 2017, Barcelona, Spain, http://icgre.org

IS - São Paulo 2017, 9th International Symposium on Geotechnical Aspects of Underground Construction in Soft Ground, April 4 and 5 2017, São Paulo, Brazil, www.is-saopaulo.com

Southeast Asian Conference and Exhibition in Tunnelling and Underground Space 2017 (SEACETUS 2017) - Innovation and Sustainable Underground Space Development, 18 – 19 April 2017, Subang Jaya, Selangor, Malaysia, nora@iem.org.my

EURO:TUN 2017 IV International Conference on Computational Methods in Tunneling and Subsurface Engineering, 18 – 20 April 2017, Innsbruck, Austria, www.eurotun2017.com

SEE TUNNEL 2017 Zagreb 7th International Symposium on Tunnels and Underground Structures in South-East Europe, May 4-5, 2017, Zagreb, Croatia, www.promovere.hr

YSRM2017 & NDRMGE 2017 Challenges and Innovations in Rock Mechanics and Engineering, 10-13 May 2017, Jeju Island, South Korea, www.ysrm2017.com

TechnoHeritage 2017 3rd International Congress Science and Technology for the Conservation of Cultural Heritage, May 20-23, 2017, Cádiz, Spain, http://technoheritage2017.uca.es

EPS'17 5th International Conference on the Use of EPS Geofoam Blocks in Construction Applications, 22-24 May 2017, Istanbul, Turkey, www.geofoam2017.org

"Landslide Research and Risk Reduction for Advancing Culture of Living with Natural Hazards"
May 29 – June 2, 2017, Ljubljana, Slovenia
www.wlf4.org

I would like to cordially invite you to be actively involved into the 4th World Landslide Forum that will be held in the Cankarjev dom – Cultural and Congress Centre in Ljubljana, Slovenia, from 29 May to 2 June 2017 under the honorary patronage of His Excellency Mr. Borut Pahor, President of the Republic of Slovenia.

The event is jointly organized by the International Consortium on Landslides (Kyoto, Japan), the International Programme on Landslides (IPL), the University of Ljubljana and the Geological Survey of Slovenia. The Forum is a contribution to the implementation of the Sendai Framework for Disaster Risk Reduction 2015-2030 which was adopted by UN Member States in March 2015 at the Third UN World Conference on Disaster Risk Reduction (3rd WCDRR) in Sendai City, Japan.

Scientists, engineers, and researchers/policy makers working in the area of landslide technology, landslide disaster investigation and landslide remediation are encouraged to share their work with the global community by submitting papers and presenting their work at the WLF4. Each participant will be given an opportunity to orally present his/her work. The reviewed contributions to the forum will be published as the forum proceedings by Springer Nature publishing house in a set of five full-color books, covering the forum 5 themes, each organized in several parallel technical sessions. The Forum will offer several important events, such as a High Level Panel Discussion of governmental representatives, a Round Table, Photo Contest and Exhibition, Student Award, Technical Exhibition, and three interesting Post-Forum Technical Study Tours.

Sincerely Yours

Matjaž Mikoš, WLF4 Forum Chair

Forum Themes

THEME 1

Sendai Partnerships 2015-2025

ICL proposed "ISDR-ICL Sendai Partnerships 2015–2025 for global promotion of understanding and reducing landslide disaster risk – Tools for Implementing and Monitoring the Post-2015 Framework for Disaster Risk Reduction and the Sustainable Development Goals" to the Third United Nations World Conference on Disaster Risk Reduction (WCDRR) held in Sendai, Japan on 14-18 March 2015. The proposal was formally accepted and sixteen intergovernmental, international and national organizations signed the Sendai Partnerships:

- International Consortium on Landslides (ICL),
- United Nations Office for Disaster Risk Reduction (UNISDR),
- United Nations Educational, Scientific and Cultural Organization (UNESCO),
- Food and Agriculture Organization of the United Nations (FAO),
- United Nations University (UNU),
- International Council for Science (ICSU),
- World Federation of Engineering Organizations (WFEO),
- International Union of Geological Sciences (IUGS),
- International Union of Geodesy and Geophysics (IUGG),
- Cabinet Office, Government of Japan (CAO),
- Ministry of Education, Culture, Sports, Science and Technology, Government of Japan (MEXT),
- Kyoto University, Japan,
- Science Council of Japan,
- National Civil Protection Department, Italian Presidency of the Council of Ministers, Government of Italy,
- National Protection and Rescue Directorate, Republic of Croatia,
- Global Risk Forum (GRF), Davos.

These partnerships are the central activities within global landslide community from 2015-2025 contributing to the United Nations International Strategy for Disaster Risk Reduction.

Session 1.1 – Sendai Partnerships 2015-2025
Objectives and Proposed Activities of Sendai Partnerships.

1. ISDR-ICL Landslide Teaching Tools.
2. Papers from 16 signatory organizations stating their profiles and possible contribution to these partnerships.

Session 1.2 – International Programme On Landslides (Ipl)

1. Activities of World Centres of Excellence and its contribution to landslide risk reduction.
2. Scientific and Technological Achievements and Activity reports of IPL projects.
3. Activities of Regional and Thematic Networks.

Session 1.3 – Landslides And Society

1. Legislation & Risk Communication for landslide risk reduction.
2. International, national and regional efforts of Capacity Building & Education.
3. Case studies of landslide risk reduction efforts integrating local and regional communities.

THEME 2

Advances in Landslide Science

There has been a significant progress in the field of landslide science in recent years. This progress can be attributed to the development of field monitoring and remote sensing technology, development of robust devices for monitoring of landslides as well as field and laboratory testing, availability of highly precision sensors, development of large scale physical modelling facilities, development of high precision and high speed computational infrastructure, 2D to 4D numerical simulation programs, availability of high resolution remote sensing imagery and data processing capabilities, and many other factors. This volume of the WLF4 will include the recent advancements made in the research and implementation pertinent to the above mentioned activities in the past couple of years.

Session 2.1 – Landslide Field Recognition & Identification: Remote Sensing Techniques, Field Techniques

1. An overview of the recent developments and research studies in landslide field recognition and identification techniques, including but not limited to various remote sensing techniques, field investigation methods, etc.

2. Keynote and invited papers on recent research and development pertinent to the landslide field recognition and identification techniques.
3. Individual papers pertinent to research studies and application of various remote sensing techniques available in practice.
4. Individual papers pertinent to various investigation techniques pertinent to landslide recognition and identification at a micro and macro scale.

Session 2.2 – Landslide Investigation: Field Investigations, Laboratory Testing

An overview of recent development at research and application of landslide investigation techniques, both in the field and laboratory levels.

1. Keynote and invited papers on recent advances in field and laboratory based landslide investigation techniques.
2. Individual papers pertinent to various in-situ landslide investigation methods.
3. Individual papers pertinent to various large and small scale laboratory based landslide investigation methods, such as laboratory testing of soils and rocks.

Session 2.3 – Landslide Modeling: Landslide Mechanics And Simulation Models

1. An overview of the recent developments and research studies pertinent to physical and numerical modeling related to landslides causes, mechanism and remediation techniques.
2. Keynote and invited papers on recent research and development pertinent to the physical and numerical modeling for landslide causes, mechanism and remediation.
3. Individual papers pertinent to research studies and application of various physical modeling techniques related to landslide causes, mechanism, and remediation.
4. Individual papers pertinent to research studies and application of various numerical modeling techniques related to landslide causes, mechanism, and remediation.

Session 2.4 – Landslide Hazard, Risk Assessment & Prediction: Landslide Inventories & Susceptibility, Hazard Mapping Methods, Damage Potential

An overview of the recent developments and research studies pertinent to landslide hazards, risk assessment and prediction techniques.

1. Keynote and invited papers on recent research and development pertinent to the landslide hazards, risk assessment and prediction techniques.
2. Individual papers pertinent to research studies and application of LS inventories and identification of landslide susceptibility.
3. Individual papers pertinent to research studies and application of various landslide hazard mapping techniques available in practice.
4. Individual papers pertinent to research studies and application of various techniques to identify the damage potential due to landslides.

THEME 3

ADVANCES IN LANDSLIDE TECHNOLOGY

The development of technology used in landslide identification, analyses, monitoring, prediction and remediation improved landslide science during last decades. In landslides risk reduction and sustainable disaster management, the main roles have three closely connected elements: monitoring, prediction and warning of landslides. Predictions of landslide occurrences are based on a deep understanding of all processes which lead to the slope failures in relationships with available measured monitoring data. Early warning system, based on landslide monitoring and prediction, is the most economical landslide risk reduction measure. Despite the significant advancement in landslides science, technology and landslide risk preparedness, the occurrences of landslide disaster are still numerous, unexpected and deadly in different reliefs and geological conditions over the world. The purpose of landslide stabilization and remediation measures is to ensure permanent stability of the slope against current and reasonably possible conditions in the slope. The successful application of each performed measure depends on correct recognition during the investigation of the specific soil and groundwater conditions in the field and application in the remediation design and each landslide stabilization design should be an original consideration about landslide geometry, active forces, soil or rock strength, and their development in time using innovative technologies.

This volume of WLF4 will include the states of the art, the best practice techniques and overall experiences on monitoring, prediction and warning of landslides caused by different triggering factors in different parts of the world. Case studies about landslide disasters under different circumstances from all aspects of landslide praxis are also welcome. Well documented consideration, analyses and design descriptions used in landslide reduction, mitigation and remediation are expected as contributions to this volume.

SESSION 3.1 – Landslide Monitoring and Warning: Monitoring Techniques And Technologies, Early Warning Systems

A state-of-the-art report of the recent developments and research studies in landslide monitoring techniques and technologies and early warning systems, including various remote sensing techniques.

1. Keynote and invited papers on recent research and development pertinent to the landslide monitoring techniques and technologies and early warning systems.
2. Individual papers pertinent to research studies and application of various landslide monitoring techniques and technologies available in practice.
3. Individual papers pertinent to various investigation techniques pertinent to landslide early warning systems.

SESSION 3.2 – Landslide Disasters and Relief: Case Studies, Emergency Measures, First Aid, Civil Protection Measures

1. An overview of recent landslide disasters in the word.
2. Keynote and invited papers on recent landslide disasters in the world.
3. Individual papers pertinent to case studies of landslide disasters and occurrences in the world.
4. Individual papers pertinent to case studies of activities related to landslide post-disaster emergency measures, first aid, civil protection measures etc.

SESSION 3.3 – Landslide Mitigation, Remediation and Stabilization: Landslide Protection Works, Landslide Stabilization and Remediation, Landslide Non-Structural Measures

1. A state-of-the-art report of the recent developments and research studies pertinent to landslide mitigation, remediation and stabilization.
2. Keynote and invited papers on recent research and de-

velopment pertinent to landslide mitigation, remediation and stabilization.

3. Individual papers pertinent to research studies and application of various methods for landslide mitigation, remediation and stabilization.
4. Individual papers pertinent to research studies and application of various non-structural methods for landslide mitigation, remediation and stabilization.

THEME 4

DIVERSITY OF LANDSLIDE FORMS

The term "landslide" describes a wide variety of processes that result in the downward and outward movement of slope-forming materials including rock, debris, soil, artificial fill, or a combination of these. The various types of landslides can be differentiated for example by the kinds of material involved, the mode of movement and velocity.

Landslide occurrence varies according to different causes such as topographic profile, geology, tectonic history, weathering and erosion history and land use and triggers such an intense rainfall event, an earthquake, a volcanic eruption, a storm wave, or rapid stream erosion.

Landslides and other types of natural hazards such as floods, droughts, wildfires, tsunamis, and volcanoes can be strongly correlated to the so-called cascade effects.

This WLF4 volume will include recent research achievements related to different landslide types in terms of typology, material and triggering factors. This volume will include also research outcomes made on the relationship between landslides and other natural hazards.

SESSION 4.1 – Earthquake-Induced Landslides

An state-of-the-art report on the more recent developments in Earthquake-Induced Landslides studies, including teoretical and praticta outcomes both from in field and laboratories experiences and analysis of the processes and mechanisms.

1. Keynote and invited papers on the most recent and innovative studies on characterization, monitoring and modelling of slopes threatened by Earthquake-Induced Landslides.
2. Individual papers pertinent to the assessment of the hazard of Earthquake-Induced Landslides at different levels ranging from regional studies to the site-specific evaluation of individual slopes.
3. Individual papers related to the evaluation of the risk assessment, management and mitigation of earthquake-induced landslides, including, but not limited to, geological, geomorphological, geotechnical, hydrogeological and economical approaches using empirical, deterministic and statistical methodologies.
4. Individual papers concerning instrumentation, monitoring technologies, prediction and early warning systems for Earthquake-Induced Landslides.

SESSION 4.2 – Rainfall-Induced Landslides

1. A state-of-the-art report on the more recent advances and researches in the field of Rainfall-Induced Landslides, including field investigation and monitoring, hazard assessment, risk management and design practices of stabilizing actions.
2. Keynote and invited papers on the most innovative research approaches and applications of methods for the analysis of Rainfall-Induced Landslides from predisposing factors and triggering causes up to geographic and societal implications.
3. Individual papers related to the development of numerical modelling for the analysis of the landslide initiation, propagation and spreading.
4. Individual papers on techniques for susceptibility and hazard assessment with deterministic and statistical approaches ranging from slope scale to regional scale and considering different geological, geotechnical and climatic settings.
5. Individual papers on risk assessment and management strategies, including empirical and physically-based thresholds, monitoring techniques, early warning systems, prevention/mitigation activities and public policies.

SESSION 4.3 – Rapid Landslides: Debris Flows, Mudflows, Rapid Debris-Slides

A state-of-the-art report of the more recent developments and research studies in the field of rapid landslides, including field investigation and monitoring, numerical modelling, hazard investigation, development of early warning systems and design of countermeasures.

1. Keynote and invited papers on the most recent and innovative research approaches for the analysis of the rapid landslides.
2. Individual papers concerning the development of numerical modelling for the analysis of landslide initiation, flowing and deposition.
3. Individual papers on risk management strategy, including monitoring techniques, early warning systems and design of countermeasures.
4. Individual papers on in-situ and laboratory experiments for the collection of data on rapid landslides and calibration/validation of models.

SESSION 4.4 – Landslides in Rocks and Complex Landslides: Rock Topples, Rock Falls, Rock Slides, Complex Landslides

1. A state-of-the-art report of the more recent advancements and findings in the Rocks and Complex Landslides studies, including field and laboratory investigations, monitoring methods, modelling processes, hazard prediction techniques, early warning systems and risk mitigation methods.
2. Keynote or invited papers on the most innovative research approaches for the identification and analysis of the Rocks and Complex Landslides at different spatial and temporal scales.
3. Individual papers on in-situ and laboratory experiments for the landslide data collection and material characterization including invasive and not invasive techniques: geotechnical and hydrogeological analysis, remote sensing approaches, geophysical techniques.
4. Individual papers concerning the identification and investigation of the preparatory factors leading to slope failure and the dynamic modelling of the post failure behavior in the spatial distribution and movement intensity.
5. Individual papers on risk management approaches, including monitoring techniques, early warning systems and countermeasures design both as prevention and as post-event solution.

SESSION 4.5 – Landslides and Other Natural Hazards: Floods, Droughts, Wildfires, Tsunamis, Volcanoes

A state-of-the-art report of the more recent developments and research studies on landslides and other natural ha-

zards.

1. Keynote and invited papers on the most recent and innovative research approaches for the analysis of the interaction between landslides and other natural hazards.
2. Individual papers related to the characterization and analysis of the natural hazard deriving, as cascade effect, from landslides (e.g. floods and tsunamis) or causing landslides during a subsequent domino effect (e.g. droughts and wildfires).
3. Individual papers concerning landslides on volcanoes: collapses influenced by volcanic activities and collapses not induced by the inner magmatic motion or external emission of juvenile material.

THEME 5

LANDSLIDES IN DIFFERENT ENVIRONMENTS

The main goal of this session is to draw attention to the different variety of landslides with respect to communities, infrastructure and cultural heritage. Landslides in the natural environment will be covered as well, including all forms of aquatic environments. Recent progress in dating techniques has greatly improved the ability to determine the age of various types of landslides. Another challenge is to relate established landslide chronologies to regional paleo-environmental changes (e.g. paleo-seismic events, deglaciation, climatic changes, and human-induced deforestation). We would also like to draw attention to the variety of landslides in the context of different climatic zones, geomorphological and geotechnical settings and triggering factors, in order to gain better knowledge of the possibilities of mitigation and risk management.

SESSION 5.1 – Landslide Interactions with the Built Environment

1. An overview of methodologies and techniques used to identify devastating effects on buildings, infrastructure and large engineering works as well as cultural heritage.
2. Keynote and invited papers on most recent progress in this topic.
3. Individual papers from risk analysis and resilience to socio-economic aspects.
4. Individual papers describing the devastating effects, which could be used for education and future scientific and technological progress.

SESSION 5.2 – Landslides in Natural Environment

1. An overview of methodologies and techniques used to analyse individual case studies from different natural environment (various climatic zones – e.g. tropical environment, alpine mountains, cold regions).
2. Keynote and invited papers on recent research progress on landslides in the natural environment.
3. Individual papers related to natural hazard analysis from different environments which predetermine a large variety of slope movements.
4. Individual papers which stress triggering factors or regional aspects.

Session 5.3 – Landslides and Water

1. An overview of methodologies and techniques used for landslide analysis associated with the aquatic environment (e.g. rivers and reservoirs, submarine and costal landslides, landslide-induced tsunamis).
2. Keynote and invited papers on recent research progress in this topic.
3. Individual papers related to landslide mitigation and risk management.
4. Individual papers associated with the large variety of predisposing factors of the aquatic environment.

SESSION 5.4 – Landslides as Environmental Change Proxies: Looking at the Past

An overview of methodologies and techniques used for landslide analysis in the context of environmental changes.

1. Keynote and invited papers on recent research progress on landslides as proxies of past climate change related to paleo-earthquakes and human-induced paleo-environmental changes.
2. Individual papers related to landslide chronologies and paleo-landslides, especially related to past environmental change.
3. Individual papers related to changes in the frequency and magnitude of landslides.
4. Individual papers related to landslide dating using historical documentary sources and tree-ring dated mass movements – high resolution datasets from the past few centuries.

SIDE EVENTS

WLF4 STUDENT SESSION

Young student landslide researchers are the key of sustainable development of landslide science and community. The WLF4 is an opportunity for them to develop international collaborative networks. Students are encouraged to present their landslide research in the form of a regular Forum paper in the student session. The first author must be a student and the paper must be presented orally by the student, the number of paper's co-authors is limited to three (i.e. since the student is the first author, 4 in total). Eligible papers will be evaluated by a panel of participating professors. Distinguished student awards (2–3) will be made to the first authors of the best presented papers judged under the different research and educational conditions of developed and developing countries. The ICL President will present the distinguished student awards to the recipients in the closing plenary session on 2 June 2017.

Contact

For requests about scientific and other academic issues please contact:

UL FGG – University of Ljubljana,
Faculty of Civil and Geodetic Engineering,
Jamova c. 2, 1000 Ljubljana, Slovenia
secretariat@wlf4.org

Rapid Excavation and Tunneling Conferrence, June 4-7, 2017, San Diego, USA, www.retc.org

IV International Course on Geotechnical and Structural Monitoring, June 2017, Rome, Italy, www.geotechnicalmonitoring.com/en

PRF 2017 Progressive Rock Failure, 5-9 June 2017, Ascona, Switzerland, www.prf2017.ethz.ch

EAgs - EurAsian Geotextiles Symposium 2017, 07 - 08 June 2017, Beijing, China, www.edana.org/education-events/conferences-and-symposia/event-detail/eurasia-geotextiles-symposium-2017

World Tunnel Congress 2017 Surface challenges – Underground solutions, 9 to 16 June 2017, Bergen, Norway, www.wtc2017.no

EUROCK 2017 Human Activity in Rock Masses, 20-22 June 2017, Ostrava, Czech Republic, www.eurock2017.com

BCRRA 2017 Tenth International Conference on the Bearing Capacity of Roads, Railways and Airfields, 28th to 30th June 2017, Athens, Greece, www.bcrra2017.com

85th Annual Meeting of International Commission on Large Dams, July 3-7, 2017, Prague, Czech Republic, www.icold2017.cz

6th International Conference on Coupled THMC Processes in Geostystems, 5-7 July 2017, Paris, France, https://geoproc2017.sciencesconf.org

10th World Congress on Water Resources and Environment "Panta Rhei", 5-9 July 2017, Athens, Greece, http://ewra2017.ewra.net

GeoMEast2017, 15 - 19 July 2017, Sharm El-Sheik, Egypt, www.geomeast2017.org

3rd International Conference on Performance-based Design in Earthquake Geotechnical Engineering (PBD-III), July 16 - 19, 2017, Vancouver, Canada, http://pbdiiivancouver.com

ICTUS17 The 2017 International Conference on Tunnels and Underground Spaces, 28 August 2017 - 1 September 2017, Seoul, Korea, www.i-asem.org/new_conf/asem17.htm

19th International Conference on Soil Mechanics and Geotechnical Engineering, 17 - 22 September 2017, Seoul, Korea, www.icsmge2017.org

SIFRMEG 2017 Shaoxing International Forum on Rock Mechanics and Engineering Geology, September 20, 2017, http://forum.hmkj.com.cn/index.php/Index/show/tid/20

AfriRock 2017, 1st African Regional Rock Mechanics Symposium, 2 – 7 October 2017, Cape Town, South Africa, www.saimm.co.za/saimm-events/upcoming-events/afrirock-2017

Geotechnique Symposium in Print 2017 Tunnelling in the Urban Environment, http://www.icevirtuallibrary.com/pb-assets/Call%20for%20Papers/Geo-Symposium-CFA-AW.pdf

HYDRO 2017 Shaping the Future of Hydropower, 9-11 October 2017, Seville, Spain, hydro2017@hydropower-dams.com

GeoAfrica 2017 3rd African Regional Conference on Geosynthetics, 9 – 13 October 2017, Morocco, http://geoafrica2017.com

3ο Πανελλήνιο Συνέδριο Φραγμάτων και Ταμιευτήρων - Διαχείριση Έργων και Προοπτικές Ανάπτυξης, 12 - 14 Οκτωβρίου 2017, Αθήνα, www.fragmata2017.gr

XIII International Conference "Underground Infrastructure of Urban Areas 2017", 24-26 October 2017, Wroclaw, Poland, http://uiua.pwr.edu.pl/?lang=en

PARIS 2017 AFTES International Congress "The value is Underground", 13-16 November 2017, Paris, France, www.aftes2017.com

World Tunnel Congress 2018
The Role of Underground Space in Future Sustainable Cities
20-26 April 2018, Dubai, United Arab Emirates
www.wtc2018.ae

The ITA-AITES World Tunnel Congress is the world's leading tunnelling event, bringing together tunnel and underground space experts and professionals from all around the world. It is the one tunnelling event you cannot miss! Join over 2000 engineers and professionals in exchanging the latest trends and innovations, learn from case studies, and discuss how tunnels will support future sustainable cities. Take the opportunity to network at multiple social events and, while you here, experience true Arabian hospitality and enjoy Dubai, the world's most cosmopolitan city, and all it has to offer.

The International Tunneling and Underground Space Association (ITA) is the leading international organization promoting the use of tunnels and underground space through knowledge sharing and application of technology. ITA represents all aspects of tunnel and underground space planning, design and construction. Since its formation in 1974, ITA has encouraged the use of the subsurface and has promoted advances in planning, design, construction, maintenance and safety of tunnels and underground space. Currently, over 70 Member Nations and hundreds of Corporate and Individual Affiliate Members are members of ITA.

Each year, ITA holds its General Assembly meeting and, at the same time, holds the World Tunnel Congress (WTC) in a different Member Nation around the world. WTC is the foremost international conference on tunneling and underground space where participants gather and share information to improve their industry. In 2016, the WTC will be held in San Francisco hosted by the Underground Construction Association (UCA).

Conference Topics

- Multi-Utility Tunnels – The ultimate solution
- Contractual Risk Sharing – a win / win arrangement
- The right tunnelling construction method for the right application
- Maintenance free design in sewer tunnels – Fact or Fiction
- Urban dewatering and flood control with underground structures
- Review of current tunnel design methods for mined tunnelling methods
- Innovation in Tunnelling technologies
- CAPEX vs. OPEX – how to define life cycle project cost
- Sustainable use of underground space

- Ground engineering and risks management
- Advances in the material sector
- Repair and maintenance of underground structures
- Smart City – how can underground space contribute
- The importance of Project Management in Project development
- Case studies on TBM projects
- Life Safety for underground structures

Contact

Host: Society of Engineers - UAE
Tel: +971 4-2399555
Fax: +971 4-2398887
Email: conferences@soeuae.com
Website: www.soeuae.ae

Congress Secretariat

MCI Middle East
United Arab Emirates
Tel: +971 4 311 6300
Fax: +971 4 311 6301
Email : wtc2018@mci-group.com

EUROCK 2018
22-26 May 2018, Saint Petersburg, Russia

Contact Person: Prof. Vladimir Trushko
Address: 21-st line V.O., 2
199106 St. Petersburg
Russia
Telephone: +7 (812) 328 86 71
Fax: +7 (812) 328 86 76
E-mail: trushko@spmi.ru

16th European Conference on Earthquake Engineering (16thECEE), 18-21 June 2018, Thessaloniki, Greece, www.16ecee.org

CPT'18 4th International Symposium on Cone Penetration Testing, 21-22 June 2018, Delft, Netherlands, www.cpt18.org

RockDyn-3 - 3rd International Conference on Rock Dynamics and Applications
25-29 June 2018, Trondheim, Norway
www.rocdyn.org

The Third International Conference on Rock Dynamics and Applications (RocDyn-3) will be held on 25-29 June 2018 in Trondheim, Norway. It is a specialized conference supported by the ISRM –International Society for Rock Mechanics and the NBG – the Norwegian National Group of Rock Mechanics.
Rock dynamics deals with the mechanical behavior of rock materials and rock masses subjected to dynamic loading. The topics include the propagation of stress waves, the stability of mining slopes, tunnels and underground caverns, rockbursts, the behavior of ground support elements and systems, rock blasting, percussive drilling, earthquake-induced damages to rock structures and landslides, etc. RocDyn-3 will cover the recent developments of both on-site practices and laboratory and theoretical studies on the above topics. Rockburst and seismic management will be paid special attentions in the conference. Two special forums will be organized for open discussions on the topics of (1) Rockburst and Dynamic Rock Support, and (2) Dynamic Testing of Rock. Experienced on-site engineers and researchers in both mining engineering and civil tunneling are invited to attend the Forums for open discussion of commonly interested issues on these two topics.

Trondheim is the third largest city of Norway. It is the city of technology in Norway, which hosts the largest Norwegian University, NTNU – Norwegian University of Science and Technology, and many other research and development institutions.

RocDyn-3 organizers would like to welcome scientists, engineers and students involving in rock dynamic issues both in laboratory and on site to join us in Trondheim to share our knowledge on these topics.

Dr. Charlie C. Li, Co-Chair & Dr. Zongxian Zhang, Co-Chair
RocDyn-3 Organising Committee

THEMES

RocDyn-3 is a specialized conference devoting to topics on the dynamic behavior of rock and rock masses and engineering applications. The themes include:

- **T1**: Laboratory dynamic testing of rock;
- **T2**: Theories and numerical simulations;
- **T3**: Rockburst, dynamic loading and seismicity in underground excavations;
- **T4**: Dynamic rock support;
- **T5**: Seismic monitoring and management;
- **T6**: Blasting and explosions;
- **T7**: Earthquake-related structure damage and landslides;
- **T8**: Other relevant topics.

- **Forum 1**: Rockburst and dynamic rock support
- **Forum 2**: Dynamic testing of rock

The Forums are held in forms of invited presentations, open speeches and discussions. The invited presentations will be selected among the submitted papers.

For all queries regarding RocDyn-3, please contact: RocDyn-3 Conference Secretariat
Email: contact@rocdyn.org

GeoChina 2018

5th GeoChina International Conference
Civil Infrastructures Confronting Severe Weathers and Climate Changes:
From Failure to Sustainability
July 23-25, 2018, HangZhou, China
http://geochina2018.geoconf.org

On behalf of the Organizing Committee, we are pleased to invite you to attend the 5th GeoChina International Conference 2018 to be held in HangZhou, China from July 23 to 25, 2018. This Civil Infrastructures Confronting Severe Weathers and Climate Changes Conference is endorsed by a number of leading international professional organizations.

This conference will provide a showcase for recent developments and advancements in design, construction, and safety Inspections of transportation Infrastructures and offer a forum to discuss and debate future directions for the 21st century. Conference topics cover a broad array of contemporary issues for professionals involved in bridge, pavement, geotechnical, tunnel, railway, and emerging techniques for safety Inspections. You will have the opportunity to meet colleagues from all over the world for technical, scientific, and commercial discussions.

Conference Themes

I: Transportation Geotechnical Engineering

- Non-Destructive Characterization of Geomaterials
- In-situ Test Methods for Site Characterization, Design and Quality Control of Earth Structures and Subgrades
- Soils and Rock Instrumentation, Behavior and Modeling
- Advances in Unsaturated Soil, Seepage, and Environmental Geotechnics
- Soil Behavior and Laboratory Testing
- Foundation Failure and Repair
- Earth Retaining Walls and Slope Stability
- Bridge Approach Embankment
- Geosynthetic Reinforced Soil Retaining Structure
- Engineering Issues in Ground Subsidence
- Dynamic Behavior of Soils and Foundations
- Physical, Numerical, Constitutive Modeling of Soil Behavior
- Innovative and Sustainable Geomaterials and Geosystems
- Transportation Issues in Developing Countries

II: Pavement Engineering

- Airfield pavement analysis, rehabilitation and performance
- Recycled Asphalt Pavement
- Pavement Design, Modeling, Performance Evaluation, & Management
- Sustainable Long Life Pavement
- Ground Improvement, and Chemical / Mechanical Stabilization for Pavement and Geotechnical Applications
- Moisture Damage in Asphaltic Concrete Materials
- Geotechnical Properties and Their Effects on Portland Concrete Pavement Behavior and Performance
- Warm Mix
- Rehabilitation strategy selection and preventative maintenance treatments
- Accelerated Testing of Pavement Structures and Materials
- Material, Design, Construction, Maintenance and Testing of Pavement
- Asphalt Binder and Mixture Characterization
- Construction and Rehabilitation of Jointed Concrete Pavement, Reinforced Concrete Pavement, and Continuously Reinforced Concrete Pavement
- Bridges Deck Pavement
- Stabilization, Recycling, Foamed Bitumen and Emulsion, Granular Materials
- Roadway Widening
- NanoTechnology & Its Application to Civil Infrastructure
- Asphalt Mix-Design, HMA Testing, & Material Property Characterization

III: Bridge Engineering

- Non-Destructive Evaluation, Inspection Technologies, Structural Health Monitoring, Remote Monitoring of Structures, Scour Assessment
- Seismic Design Issues for Bridges, and Underground Structures
- Design Methods and Materials, Innovative Repair Methods and Materials, Durable and Sustainable Designs, Innova tive Materials, Advances in Foundation Design/Construction, Accelerated and/or Performance Based Design/Construction, Aesthetics and Environment
- State-of-the-Arts and State-of-the-Practices on Bridge Design, Construction and Maintenance.
- Special Foundation Treatment and Settlement Control Technology

IV: Tunneling Engineering

- Tunnel Management and Inventory, Monitoring and Settlement Control
- Emerging Technologies, Lining Design & Precast Segment Advances
- Innovation in Tunneling Design, Construction, Repair, Rehabilitation
- Fire & Life Safety, Vulnerability & Security
- Tunneling in Soft Ground, Ground Conditioning and Modification
- Advanced prediction technology of tunnel construction geology
- Deep excavations and urban tunnelling

V: Railroad Engineering

- Railway Track Substructure
- High Speed Rail System
- Seismic Design for Railway Structures
- Economics of Railway Engineering and Operations
- Structures, Maintenance and Construction

VI: Dam, Geomatics, Geoscience, Geophysics, and Hazards

- Dam Engineering, Geo-Sciences, Geomatics, Geophysics, and Gravity
- Geophysical Testing in Civil and Geological Engineering in Transportation Geotechnical Engineering.
- Natural Hazard and Disaster Monitoring in Transportation Geotechnical Engineering.
- Seismically Induced Hazards and Mitigation in Transportation Geotechnical Engineering.
- Extreme-Hazard Resilient Structures - Risk/Reliability Assessments, Emergency Management Practices, Multi-hazard Design, Enhanced Post-Earthquake Serviceability, Scour Assessment and Restoration, Quality Control/Quality Assurance in Bridge Engineering.
- Geological Disaster Control Technology

Secretary Generals

Dr. Jinfeng Wang, Dr. Dar Hao Chen

Contact Email: Geochina.Adm@Gmail.Com

UNSAT2018 The 7th International Conference on Unsaturated Soils, 3 - 5 August 2018, Hong Kong, China, www.unsat2018.org

11th International Conference on Geosynthetics (11ICG), 16 - 20 Sep 2018, Seoul, South Korea, www.11icg-seoul.org

ARMS10
10th Asian Rock Mechanics Symposium
ISRM Regional Symposium
29 October - 3 November 2018, Singapore
www.arms10.org

On behalf of the Organizing Committee for ARMS 10, it is my pleasure to invite you to Singapore for the 10th Asian Rock Mechanics Symposium cum the ISRM International Symposium for 2018.

The theme for ARMS 10 is "Rock Mechanics in Infrastructure and Resource Development".

Asia is witnessing the greatest growth and demand in the world for infrastructure and resource development. According to Asian Development Bank, approximately US$8 trillion needs to be invested in overall national infrastructure before 2020, 68% of which is for new capacity. Certainly, rock mechanics and rock engineering will have a critical role to play in many of these infrastructure and resource development projects.

Singapore is ideally located in Asia, where the needs for infrastructure and resource development are well supported by high-level research from the Academia and governments. ARMS 10 Singapore 2018 offers an ideal opportunity and platform for professionals from the international rock mechanics community to exchange experiences and new ideas. In addition to the technical programs, we will organize training courses, workshops, technical visits, exhibitions, as well social programs. We will also offer attractive programs for young researchers and students, such as the Rock Bowl, student nights, and some scholarships for selected young researchers.

Yingxin ZHOU, Conference Chairman

Theme

Rock mechanics in resource and infrastructure development

Topics

- A: Site investigations and rock masscharacterisation
- B: Rock properties and testing
- C: Rock mass classifications
- D: Rock caverns and tunnels
- E: Rock slopes and foundations
- F: Rock support and ground improvement
- G: Excavation and extraction methods
- H: Hydro-fracturing and borehole stability
- I: Numerical modelling
- J: Design methods and analysis
- K: Rock dynamics and seismic design
- L: Nuclear power plants and waste disposal
- M: Instrumentation and monitoring
- N: Geohazards and risk management
- O: Innovations and technology advancement
- P: Smart mining and rock engineering (3D printing; GIS and 3D modelling; 3D scanning & mapping; wireless sensors, etc)
- Q: Utilisation of rock cavern space
- R: Special rock engineering projects and case studies
- AA: Interdisciplinary

Contact Us

ARMS10 Secretariat at Meeting Matters International
Tel: (65) 6472 3108 | Fax: (65) 6472 3208
Address: 1 Commonwealth Lane, #06-23 ONE COMMONWEALTH, Singapore 149544
Email: ARMS10@meetmatt.net

14th ISRM International Congress
20-27 September 2019, Foz de Iguaçu, Brazil

Contact Person: Prof. Sergio A. B. da Fontoura
E-mail: fontoura@puc-rio.b

ISDCG 2019
7th International Symposium on Deformation Characteristics of Geomaterials
26-28 June 2019, Strathclyde, Scotland, UK,

The Technical Committee 101 of the ISSMEG is pleased to announce the organisation of the 7th International Symposium on Deformation Characteristics of Geomaterials (ISDCG) in 2019, in Glasgow, UK. The symposium is co-organised by the University of Strathclyde in Glasgow, the University of Bristol, and the Imperial College in London.

Building on the success of the previous Symposia organised in Sapporo (Japan) Japan in 1994, Torino (Italy) in 1999, Lyon (France) in 2003, Atlanta (US) in 2008, Seoul (Korea) in 2011 and Buenos Aires (Argentina) in 2015, the 7th ISDCG will equally follow both its traditions and active promotion of new technical elements to maintain it as one of the most popular and vibrant events within the geotechnical community. The technical core themes will focus on: (i) advanced laboratory geotechnical testing; (ii) application of advanced laboratory testing in research, site characterisation, and ground modelling; (iii) application of advanced testing to practical geotechnical engineering. In addition to these traditional topics, sub-themes will include cutting-edge techniques and approaches, for example experimental micro-mechanics, non-invasive monitoring systems, nano and micro-sensors, new sensing technologies. A key goal is to engage with the full spectrum of geotechnical specialists, from early career engineers and researchers through to world leading experts.

The 17th European Conference on Soil Mechanics and Geotechnical Engineering
1st - 6th September 2019, Reykjavik Iceland
www.ecsmge-2019.com

The theme of the conference embraces all aspects of geotechnical engineering. Geotechnical engineering is the foundation of current as well as future societies, which both rely on complex civil engineering infrastructures, and call for mitigation of potential geodangers posing threat to these. Geotechnical means and solutions are required to ensure infrastructure safety and sustainable development. Those means are rooted in past experiences enhanced by research and technology of today.

At great events such as the European Geotechnical Conference we should: Spread our knowledge and experience to our colleagues; Introduce innovations, research and development of techniques and equipment; Report on successful geotechnical constructions and application of geotechnical design methods, as well as, on mitigation and assessment of geohazards and more.

Such events also provide an opportunity to draw the attention of others outside the field of geotechnical engineering to the importance of what we are doing, particularly to those who, directly or indirectly, rely on our services, knowledge and experience. Investment in quality geotechnical work is required for successful and safe design, construction and operation of any infrastructure. Geotechnical engineering is the key to a safe and sustainable infrastructure and of importance for the society, economy and the environment. This must be emphasized and reported upon.

ΕΝΔΙΑΦΕΡΟΝΤΑ ΓΕΩΤΕΧΝΙΚΑ ΝΕΑ

Huge sinkhole swallows street in Fukuoka, Japan

A giant sinkhole swallowed a five-lane street in the centre of one of Japan's biggest cities on Tuesday morning.

The collapse began at around 05:00 local time (20:00 GMT Monday) near Hakata Station, the busiest in Fukuoka city in the southern island of Kyushu.

It began with two smaller holes that grew steadily until they formed one huge depression around 30m (98ft) wide.

There were no reports of serious injuries but it disrupted power, water, gas and transport links in the area.

Broadcaster NHK reported that an elderly lady slipped on some stairs because of the power cut.

Engineering work to extend a nearby underground train line may be related to the sinkhole's sudden appearance, city officials said.

(BBC NEWS, 8 November 2016, http://www.bbc.com/news/world-asia-37906065)

Giant sinkhole in Japan repaired in matter of days

Huge sinkhole repaired in under a week

In the end, it disappeared almost as quickly as it had appeared.

A giant sinkhole which swallowed a chunk of road the length of a city block in the southwestern Japanese city of Fukuoka has been filled mere days after it appeared, a testament to Japanese engineering and efficiency.

Before

After

After the sinkhole appeared on November 8, subcontractors worked around the clock to fill in the 30 meter (98 ft) wide, 15 meter (50 ft) deep hole by the 12th with a mixture of sand and cement. The job was complicated by the water which had seeped in from sewage pipes destroyed by collapsing sections of road.

A giant sinkhole has opened up in Fukuoka, Japan, swallowing huge sections of road including traffic lights, near to underground work to extend a subway tunnel. Will Barker was close to Hakata Station and captured this image, showing emergency vehicles blocking access to the road. He told CNN: The hole was interesting, so I went to investigate.

After that it only took another 48 hours to reinstall all utilities -- electricity, water, sewage, gas and telecommunication lines -- and to resurface the road. There were no reports of injuries.

The gigantic sinkhole opened suddenly last week in Hakata ward in Fukuoka's business district, swallowing huge sections of road near underground work to extend a subway tunnel.

City officials were working nearby to extend the subway from a nearby station to the city center along a 1.4-kilometer (0.86 mile) route.

Motohisa Oda, a crisis management officer from the city of Fukuoka, told CNN that the underground construction work may have triggered the collapse.

The gaping hole -- which started off as two smaller ones before merging into the larger cavity -- appeared 300 meters from the JR Hakata station, one of the city's main transport hubs.

The mayor of Fukuoka, Soichiro Takashima, said the affected ground had been strengthened by a factor of 30 because of the sand and cement refill.

Previously comprised largely of sand, the soil's composition was suspected to be a part of the cause for the huge hole, according to local civil engineering experts.

(McKirdy and Yoko Wakatsuki / CNN, November 15, 2016, http://edition.cnn.com/2016/11/15/asia/fukuoka-sinkhole-filled)

Japan's giant sinkhole is sinking again

A giant sinkhole that was hastily repaired in Japan earlier this month is showing signs of movement.

Traffic was stopped at the busy intersection in Japanese city of Fukuoka on the weekend after the road was seen to sink some seven centimeters (2.7 inches).

Earlier this month, a 30 meter (98 feet) wide, 15 meter (50 feet) deep hole suddenly opened, swallowing five lanes of road and flooding with water.

It was repaired in a matter of days in what was seen as a testament to Japanese engineering and efficiency.

Some doubt was raised over those plaudits Saturday however, when traffic had to be stopped around the hole as a section of road began sinking again. The road has since been re-opened.

On Facebook, Fukuoka mayor Soichiro Takashima apologized for not warning residents the ground could sink again.

City officials told CNN some movement had been expected as the sand and cement used to fill the hole settle.

(James Griffiths and Yoko Wakatsuki / CNN, November 28, 2016, http://edition.cnn.com/2016/11/28/asia/japan-sinkhole-fukuoka/index.html)

Tunnelling: Big projects get bigger

TBM assembly in the test tunnel of the French Frejus project between Lyon and Turin

Europe set the tunnelling pace this summer as first high speed trains ran through the 57km long AlpTransit Gotthard base tunnel, in Switzerland, the world's longest transport tunnel, and the deepest at 2,200m.

The tunnel has taken 20 years of planning and construction.

But this is not the last word. An even longer link is well underway from Austria's Tyrol to Italy, and significant works continue on the French Frejus project between Lyon and Turin, 57km long like the Gotthard.

Gotthard's AlpTransit client, meanwhile, is completing work on a shorter but significant 16km long complement at Ceneri further south, and two other long and deep rail tunnels are in construction in Austria.

Another has just begun in Norway, which is also building the world's deepest undersea road tunnel. Sweden has begun its giant city bypass project for Stockholm. Germany's complex multi-tunnel Stuttgart 21 project is in full swing, and Italy is beginning work with the biggest TBM (tunnel boring machine) seen in Europe.

The €8.5 billion Brenner base tunnel will be a record too when complete in 2025.

Its basic length is 55km between main portals at Fortezza in Italy and Innsbruck in Austria, but a connection into the 9km Innsbruck bypass tunnel means a total 64km of underground travel for some high-speed trains.

The depth will be 1,800m beneath giant mountains, and the challenges for excavation and operation include hot rock conditions near to those on the Swiss project, and possible bursting or squeezing ground.

Access tunnels are complete or in construction, including a new service and safety tunnel alongside the existing twin track Innsbruck bypass, as well as smaller tunnels for waste disposal.

Exploration

Five main project sites are busy, at the two portals and three intermediate lateral access tunnels, to twin single bore main drives. These are 8.1m inner diameter, and between 40m and 70m apart. A smaller 5m diameter tunnel runs between and below the main drives, for exploration initially, and then drainage and access in the operational period.

Big challenges have included crossing a severely crushed zone of rock in the Italian half of the project – a 1.5km sector that could have stalled the whole scheme now successfully excavated with drill and blast (D&B), both for the exploratory tunnel and the main drives.

Current €380 million works at Innsbruck will also drive a 15km long extension to the initial 6km exploratory tunnel southwards, using a Herrenknecht hard rock TBM. Its unshielded front section allows detailed inspection of rock conditions to inform main drives later.

But this summer, the big contracts for the main drives were being let, said Brenner Base Tunnel spokesman Simon Lochmann.

"On the Austrian side, the Wolf access is essentially finished and we are ready to tender the Austrian main section from there, with 9km of the exploratory north and south, and then the main bores too. It is an estimated €1.3 billion," he said.

On the Italian side, one of the biggest contracts has just been let to a five-firm consortium including Astaldi, Ghella, Oberosler Cav Pietro, Cogeis and PAC, a €1 billion package for 15km of exploratory tunnel and 40.3km of main tunnel, as well as an emergency station cavern.

Work has also begun on complex portal works at the south end, including ground freezing to take the tunnel underneath a river.

For the €8.8 billion French-Italian Frejus project between Turin and Lyon, most of the exploratory and access tunnels are finished, and a first main bore is underway on the French side. The inner diameter will be slightly larger than Gotthard and Brenner, giving clearance for lorry shuttle trains.

This first 9km long section is intended first as an experimental bore through possibly squeezing ground, testing TBM performance, but will later be part of the route.

Specially designed

Contractor Spie Batignolles is using a specially designed high-powered TBM from French maker NFM with capacity to "overcut" up to 11.26m diameter to allow for ground convergence. Christened Federika, it arrived in the summer and has begun its drive.

The AlpTransit project, meanwhile, continues with the 15.4km long twin bore at Ceneri which will take a further ten minutes from the Zurich to Milan route. Drill and blast with Sandvik rigs and a Rowa backing train finished in January when the two difficult 8km northern drives broke through. Two southern drives finished last year.

"Lining is almost complete," said AlpTransit project manager Paolo Vicentini, with the tunnels readied for track and electrical work. Satisfaction has been marred somewhat by a tragic fatality, he said, when a tunnel miner was hit by a reversing spoil truck.

In Austria, meanwhile, two more major deep tunnels are underway. One is the 32.9km Koralm for a completely new high-speed rail link between Klagenfeldt and Graz.

The twin bore tunnel runs up to 1,250m below the 2,000m high Koralpe mountains, causing some rock convergence. Though the "hot rock" problem of the bigger tunnels is present, it is less extreme.

Contractor Strabag has struggled with two 17km-plus long drives on the overall 19km central section through difficult hard, tough and blocky rock, using two 9.9m diameter CREG-Wirth TBMs (formerly Aker-Wirth).

Progress has been steady since they set out in mid-2012, but slower than expected. The 9.7m diameter machines install a segment lining.

The TBMs have currently reached a point 19km from the tunnel portal, said the project director for the overall Koralm project, Klaus Schneider, from client Austrian Rail's infrastructure division ÖBB-Infrastruktur. That leaves just under 2km to go on each drive.

Drill and blast work is also underway on a 900m long safety station between the two parallel TBM drives.

On Koralm's west side, Austria's Porr has been working since 2014 on a 12km drive for the south bore with a multimode Herrenknecht TBM. The other bore was part excavated to over 6km early on for exploration, and is being completed by drill and blast.

Porr has done 3km with the TBM, which shortly has to be converted from soft ground EPB operation to the hard rock further in. The D&B bore is at the 9km point so far.

Despite slow progress, both the tunnel and the overall railway scheme remain within the overall completion envelope, said Schneider.

Not content with two deep tunnels, Austria embarked on the 27km long Semmering project in 2014, 800m deep and straight underneath the historic 1854 Semmering mountain railway between Graz and Vienna – a scenic but difficult sinuous line. Geology here is heterogeneous with multiple faulting and water saturated rocks.

Conventional drive

Three major contracts are using conventional methods to get through, though a TBM can be used for a central 9km section, the Fröschnitzgraben. For this, access has to be gained via two completed 400m deep shafts, begun in 2014 by a joint venture of Implenia and Svedelski, which is now working on the TBM launch cavern. The joint venture will also do 4.4km of conventional drive for the twin tunnels in the other direction.

A 7km length from the Gloggnitz portal is underway by a joint venture of Implenia, Hochtief Infrastructure and Thyssen Schachtbau, using mainly drill and blast and currently about 900m in.

A final section, also a 7km conventional drive, is by Swiss joint venture Marti with Marti Tunnelbau, and began in May this year.

Norway has also embarked on a high speed line, the 22km long Follo line project, with twin bores running 20km south from Oslo to Ski, through a low mountain. It is not a deep line, at less than 100m depth.

Four Herrenknecht 9.9m diameter TBMs were assembled this summer in two linked 54m long caverns at a central access halfway along the main 18.5km tunnel section.

The Spanish-Italian joint venture of Acciona Infraestructuras and Ghella worked with lift contractor Mammoet to put together the huge components. The two pairs of TBMs were setting out north and south this autumn for approximately three years of excavation.

An additional 1.5km section continues the tunnel near to Oslo. Italian contractor Condotte D'Acqua is using drill and blast thread through a complicated spaghetti of existing tunnels. It is also using rock splitting to avoid vibration close to existing road and water routes, using hydraulic Superwedges from Italian maker Ripamonti.

Norway usually favours drill and blast, but two more TBMs have also been working lately. First is another Herrenknecht on a railway project into west coast city Bergen, where a second bore will relieve congestion on the existing single track Ulriken tunnel. Sweden's Skanska and Austria's Strabag are about halfway along the 7.5km drive at present.

The client side project manager for the scheme, Hans-Egil Larsen from Norway's National Railway Administration, said a TBM was better because the new bore was only 30m from the old line which must continue running. Drill and blast vibration would have been disruptive.

Hydroelectric

Further north, a 7.2m diameter Robbins main beam machine broke through last December for the 7.4km long headrace tunnel on the Røssåga hydroelectric project.

Its nearly two-year drive had involved "boring through quartz-rich rock up to 300MPa, as well as softer karstic limestone with water ingress," according to Tobias Andersson, TBM manager for contractor Leonhard Nilsen & Sønner.

Norway's traditional drill and blast is being applied further south in oil port Stavanger. The NOK6 billion (€700 million) Ryfast scheme is a three twin-tube tunnel project to connect western suburbs across a surrounding deep fjord.

Two tunnels are 4km and 5.5km, but the main Solbakk tunnel will be 14.3km long, diving 290m deep. Cross section is small, however, at 8.5m width after lining, with two 3.25m traffic lanes in each bore.

Work is in two halves with Swiss firm Marti beginning the eastern side in August 2013 using a Marti Technik conveyor system and Sandvik drill rigs, and FA Gruppen using an Atlas Copco drill at the other with more traditional truck mucking out.

Two main types of rock are present, hard gneiss on the eastern side, and a softer phyllite claystone on the west.

Project director for the overall scheme Gunnar Eiterjord, from client Statens Vegvesen (the Norwegian Public Roads Administration), said that currently around 12km of the 14km had been excavated and that progress was good.

Bigger and deeper

An even bigger and deeper project is in final design preparation, however, as part of Norway's no-ferries E39 west coast highway scheme. The Rogfast, running north out of Stavanger, will be 25km long and 380m deep below the sea.

Next door, Sweden is busy too with initial works begun on the massive Stockholm bypass this spring, blasting access and works tunnels and caverns.

The ten-year project is for a full dual three-lane highway running nearly 20km in twin tunnels around the western side of the city to alleviate severe congestion. The city is set within an area of Baltic islands and inland lakes which, while scenic, leaves it with only three connections north to south.

To bypass the capital, the new motorway must go up to 70m underground below royal parkland and nature reserves on islands to the west.

Major junctions will also be partly underground, using an additional 14km of ramp tunnel, and there is further work for seven access tunnels. The client, the Swedish Road Authority, is letting six major tunnel contracts at present, each around €300 million, and six for junctions to start shortly.

Early work for access is under several smaller €50 million range contracts, including with Czech contractor Subterra at the southern end.

Germany, meanwhile, is pressing on with the multiple tunnels of its €5.8 billion Stuttgart 21 underground station project and the associated Stuttgart-Ulm high-speed rail scheme with four major tunnels.

The first of four TBM sections are complete for the 9.5km long Filder tunnel, Stuttgart 21's most difficult.

The 4km drive towards the city from the airport finished earlier this year just before entering a region of expansive anhydrite rock. The calcium sulphate expands strongly if it is saturated with water, and NATM (new Austrian tunnelling method) with modified drill and blast and special measures are being used to prevent water ingress.

The TBM, meanwhile, has been pulled back by contractor Porr, leading a consortium on the work, and is just under halfway along the second bore's first drive.

The central NATM section must be complete by the time it gets there because the TBM will be pulled through the 2.5km length to continue the bore on the far side of the sensitive rock area with a further 3.6km drive. Then it turns around to go back uphill for the last section of the first bore.

Around Stuttgart station, major soft ground NATM caverns have been completed for work on the lines into the station. From these extensive compensation grouting will be done.

Dry work is also needed on another of the surrounding tunnels, the Feuerbach which also has anhydrite, according to drill maker Sandvik. Working with drilling subcontractor Avesco, it has specially modified drills, refitted with air cooling for the hydraulics and air flushing for the boreholes with additional dust filters.

Avesco has also done substantial work for main contractors Züblin and Max Bögl on one of the major tunnels for the €3.3 billion high-speed line connection to Ulm from Stuttgart suburb Wendlingen. Some nine Sandvik machines have worked on the 5.3km long Albabstieg tunnel into Ulm from the Schwäbishche Alps highlands.

Austria's Porr, leading the same team as at Filder, is well advanced on the two tunnels which climb the highland – the 8.8km long Bossler, and the 4.8km Steinbühl.

The Steinbühl, excavated by drill and blast, has almost completed lining work for the bores. Bossler is finished for the first of two bores where some 7km has been done by a Herrenkencht EPB (earth pressure balance) machine, 3km more than originally supposed. Squeezing ground conditions have not been as difficult as expected and drill and blast was not needed.

Work has just begun by contractor Implenia on the last of the major tunnels, the 8.2km Albvorland tunnel through softer ground closer to Wendlingen before the Schwäbische Alp section, according to a spokesman for client Deutsche Bahn.

Two TBMs will drive simultaneously to ensure relatively fast completion as this tunnel is on the critical path.

Finally, Herrenknecht is readying Europe's biggest TBM ever for the 7.52km long Santa Lucia road tunnel near to Florence in Italy.

The contractor is Pavimental. At a diameter of 15.87m, the EPB machine is 200mm bigger than Herrenknecht's previous largest, used in the Italian Apennines, on the now complete Sparvo tunnel.

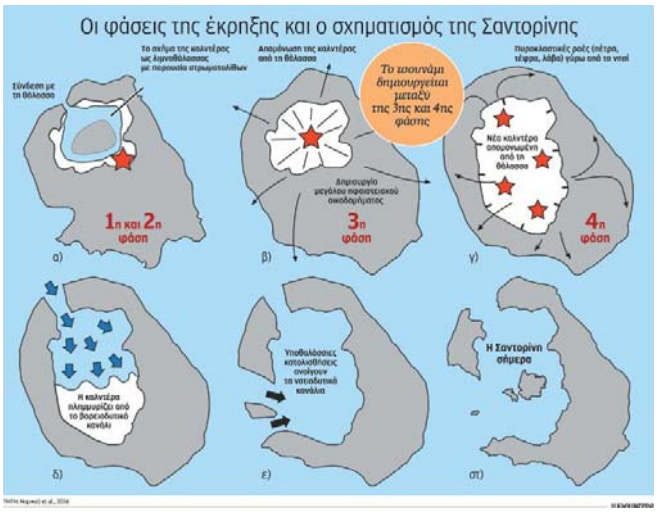
(Adrian Greeman / CONSTRUCTION europe, 23 Nov 2016, http://www.khl.com/magazines/construction-europe/detail/item123226/Tunnelling:Big-projects-get-bigger)

Peru hotel collapses into river in dramatic caught on camera video

https://www.youtube.com/watch?v=Phv5bwslgzY

ΕΝΔΙΑΦΕΡΟΝΤΑ - ΣΕΙΣΜΟΙ

Νέα δεδομένα για το τσουνάμι της Σαντορίνης



Πλέοντας προς το λιμάνι της Σαντορίνης από τη βορειοδυτική πλευρά του νησιού, το πλοίο περνάει ανάμεσα από το φυσικό άνοιγμα μεταξύ της Θηρασίας και της Οίας, σε ένα σημείο που όλοι έχουν στον νου το μοναδικό ηλιοβασίλεμα. Η ανακάλυψη ενός υποθαλάσσιου καναλιού σε εκείνο το άνοιγμα από την επίκουρη καθηγήτρια Γεωλογικής Ωκεανογραφίας του Εθνικού και Καποδιστριακού Πανεπιστημίου Αθηνών Παρασκευή Νομικού και τη διεθνή ομάδα της ήταν η αρχή για να έρθουν στο φως νέα επιστημονικά δεδομένα για την έκρηξη του ηφαιστείου της Σαντορίνης πριν από 3.600 χρόνια και τη δημιουργία του τεράστιου τσουνάμι που σήμανε την αρχή του τέλους της Μινωικής Εποχής.

Σύμφωνα με τα νέα στοιχεία, το τσουνάμι προκλήθηκε από την ισχυρότατη εκτίναξη των πυροκλαστικών ροών (τέφρα, ελαφρόπετρα, λάβα) προς τη θάλασσα και όχι από την κατάρρευση και καταβύθιση της καλντέρας, η οποία ακολούθησε της έκρηξης, όπως υποστηρίζουν οι επιστήμονες στο άρθρο τους με τίτλο «Post-eruptive flooding of Santorini caldera and implications for tsunami generation» («Μεταηφαιστειακός κατακλυσμός της καλντέρας της Σαντορίνης και ενδείξεις για τη δημιουργία τσουνάμι») που δημοσιεύθηκε μόλις χθες στο έγκριτο επιστημονικό περιοδικό «Nature Communication».

Με άλλα λόγια, αλλάζει η επικρατούσα θεωρία που έλεγε ότι η κατάρρευση ενός ηφαιστειακού συγκροτήματος μπορεί να προκαλέσει τα παλιρροϊκά κύματα που οδηγούν σε τσουνάμι. «Τα βαθυμετρικά και σεισμικά δεδομένα που συγκεντρώσαμε έδειξαν ότι η καλντέρα, η κατάρρευση του ηφαιστειακού συγκροτήματος της Σαντορίνης, δεν ήταν ανοιχτή προς τη θάλασσα στην κύρια φάση της έκρηξης αλλά απομονωμένη», λέει στην «Κ» η κ. Νομικού.

Στο γράφημα που δημοσιεύει η «Κ» φαίνονται πρώτη φορά τα τέσσερα στάδια της ηφαιστειακής δραστηριότητας που κράτησε αρκετούς μήνες και το πώς ήταν σχηματισμένη η καλντέρα της Σαντορίνης κατά τη διάρκειά της. Στην πρώτη φάση υπάρχει ένα μικρό κανάλι που συνδέει τη μικρή σε μέγεθος καλντέρα με τη θάλασσα και δημιουργεί ένα είδος λιμνοθάλασσας, όπως εξηγεί η κ. Νομικού. Οι υποθαλάσσιες κατολισθήσεις και τα προϊόντα της ηφαιστειακής δραστηριότητας «μπάζωσαν» το μικρό κανάλι και πάνω από το νησί απλώθηκε ένα τεράστιο νέφος τέφρας, όπως έγινε το 2010 με την έκρηξη του ηφαιστείου της Ισλανδίας.

Με την καλντέρα απομονωμένη από τη θάλασσα, η ολοκλήρωση της ηφαιστειακής έκρηξης προκάλεσε, εξηγεί η κ. Νομικού, την εισροή θαλασσινού νερού από το κανάλι μεταξύ της Θηρασίας και της Οίας στην καλντέρα, η οποία πλημμύρισε μέσα σε δύο μέρες.

«Σκεφτείτε την εικόνα ενός φράγματος που από τη μια του πλευρά έχει νερό και από την άλλη ένα βύθισμα, μια "πεδιάδα", την καλντέρα. Το μπαζωμένο φράγμα ήταν ο "αδύναμος κρίκος" που υποχώρησε προς το τέλος της έκρηξης από την πίεση του εξωτερικού νερού. Το τσουνάμι είχε ήδη συμβεί με κύριο μηχανισμό δημιουργίας την εκτίναξη των πυροκλαστικών προς τη θάλασσα στην τρίτη και τέταρτη φάση της έκρηξης», τονίζει.

Το κανάλι που εντόπισε η κ. Νομικού και η ομάδα της, η οποία αποτελείται από καταξιωμένους επιστήμονες πανεπιστημίων του εξωτερικού, έχει μήκος 3 χλμ. και πλάτος 1 χλμ. και στις εικόνες που δημοσιεύει η «Κ» διακρίνεται μία ασυνήθιστη διάβρωση που γέννησε ερωτήματα στους επιστήμονες. «Παρατηρήσαμε μια οπισθοδρομούσα διάβρωση στο κανάλι, είναι το σχήμα της στεφάνης που δημιουργείται έξω από την Οία και τη Θηρασία και δείχνει ότι το νερό εισρέει προς το εσωτερικό και παράλληλα "σπρώχνει" και προς τα πίσω. Χαρτογραφώντας τον θαλάσσιο πυθμένα, προσπαθούσαμε να ερμηνεύσουμε πώς δημιουργήθηκαν αυτές οι υποθαλάσσιες γεωμορφές και καταλήξαμε στα παραπάνω συμπεράσματα», σημειώνει.

Τα νέα δεδομένα για το τσουνάμι της Σαντορίνης ενισχύουν (και συμφωνούν με) τη θεωρία για τις γενεσιουργούς αιτίες πίσω από το τσουνάμι που προκλήθηκε από την έκρηξη του ηφαιστείου Κρακατόα στην Ινδονησία το 1883. Οι εκρήξεις των δύο ηφαιστείων είναι οι μεγαλύτερες που έχουν συντελεστεί τα τελευταία 10.000 χρόνια.

Η τελευταία αποστολή της ομάδας στη Σαντορίνη έγινε με τη βοήθεια του History Channel για την παραγωγή του ντοκιμαντέρ «Atlantis found» το 2015. Η μυθική Ατλαντίδα μπορεί να μη βρέθηκε ακόμη, αλλά ίσως τώρα ξέρουμε πώς προκλήθηκε το τσουνάμι που την κατέστρεψε.

«Ηθελα να δω τι κρύβει η θάλασσα»

«Συζητούσαμε πάνω στα δεδομένα περίπου ένα χρόνο και τελικά και εκείνοι συμφώνησαν με τα νέα στοιχεία της έρευνας», λέει η κ. Νομικού περιγράφοντας την άριστη συνεργασία με τους δύο κορυφαίους γεωλόγους Τιμ Ντρούιτ από το ινστιτούτο ερευνών της Γαλλίας CNRS και Ντέιβιντ Πάιλ του Πανεπιστήμιου της Οξφόρδης, οι οποίοι δημιούργησαν τον γεωλογικό χάρτη της Σαντορίνης το 1990 και υποστήριζαν – μέχρι χθες– την υφιστάμενη θεωρία, ότι δηλαδή η καταβύθιση της καλντέρας ήταν ο κυριότερος παράγοντας πρόκλησης του τσουνάμι. Οι δύο καθηγητές, όπως και ο Κρίστιαν Χούμπσερ από το Πανεπιστήμιο του Αμβούργου, αλλά και 15 Ελληνες και ξένοι επιστήμονες, συνυπογράφουν το άρθρο. «Η επικρατούσα θεωρία διατυπώθηκε τη δεκαετία του 1980 και με τα μέσα που διέθεταν τότε το συμπέρασμά τους ήταν σωστό. Η τεχνολογία, όμως, προχώρησε και με τα νέα όργανα που χρησιμοποιήσαμε προχωρήσαμε την επιστημονική έρευνα ένα βήμα παραπάνω», σημειώνει η επικεφαλής της ομάδας. Τα νέα στοιχεία εκτιμάται ότι θα συμβάλουν και ίσως αλλάξουν τα μοντέλα που χρησιμοποιούν οι επιστήμονες που εξετάζουν τη δημιουργία των τσουνάμι. «Ολοι θέλαμε να δούμε πώς ήταν το σχήμα της Σαντορίνης πριν από τη μεγάλη έκρηξη και πώς ήταν η μορφολογία του εδάφους. Οι χάρτες που είχαμε ήταν με δεδομένα μόνο από την ξηρά. Οταν προστέθηκε η μορφολογία του πυθμένα και τα σεισμικά δεδομένα, που μας επέτρεψαν να "δούμε" τη στρωματογραφία κάτω από τον πυθμένα, καταφέραμε να συνδυάσουμε τα δύο στοιχεία και να αποκτήσουμε συνολική εικόνα», τονίζει.

Η Παρασκευή Νομικού γεννήθηκε και μεγάλωσε στο νησί και θυμάται τις διηγήσεις των παππούδων της για τις ηφαιστειακές εκρήξεις του '50 και του '39. «Μεγάλωσα σε ένα ηφαίστειο και όταν σπούδασα ήθελα να μάθω περισσότερα για όλα

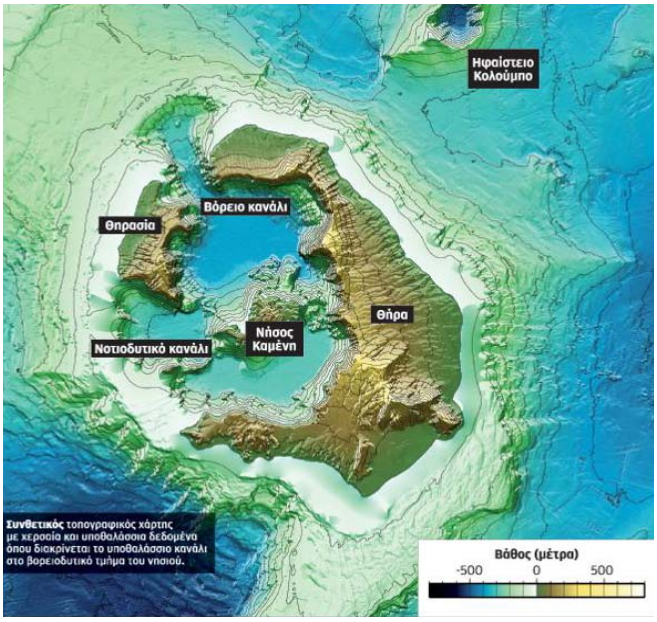
αυτά που κρύβει η Σαντορίνη κάτω από τη θάλασσα», μας λέει. Η έρευνα ξεκίνησε το 2006 και συνεχίστηκε πιο εντατικά από το 2010 με τη βοήθεια της νέας τεχνολογίας και συνεργατών από το εξωτερικό. «Η έρευνα συνεχίζεται και τώρα θέλουμε να κάνουμε ανάλυση ιζημάτων εντός της καλντέρας και να δούμε μέχρι πού εξαπλώνονται οι πυροκλαστικές ροές, να γίνει πιο εμπεριστατωμένη έρευνα γύρω από το ηφαίστειο της Σαντορίνης», καταλήγει. Για όσους ανησυχούν, το ηφαίστειο «κοιμάται»...

Η ακμή του νησιού κατά την έκρηξη

Στη μεγάλη της ακμή βρισκόταν η Θήρα, σύμφωνα με τα αρχαιολογικά δεδομένα, όταν σημειώθηκε η μεγάλη έκρηξη της Υστερης Εποχής του Χαλκού. Η πόλη του Ακρωτηρίου ήταν αστικό κέντρο και κοσμοπολίτικο εμπορικό λιμάνι, από τα πιο σημαντικά της Ανατολικής Μεσογείου, ο πληθυσμός της διέθετε όλα τα χαρακτηριστικά μιας πλούσιας, καταναλωτικής κοινωνίας. Είναι πολλά τα στοιχεία που μαρτυρούν τη μεγάλη του ανάπτυξη.

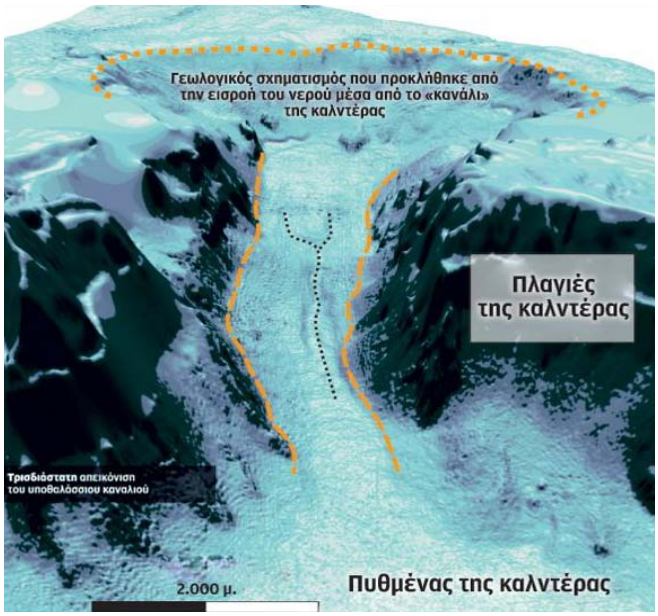
Ο αρχαιολόγος της Σαντορίνης Χρίστος Ντούμας έχει γράψει σχετικά με την έκρηξη: «Της εκρήξεως φαίνεται ότι προηγήθηκαν σεισμικές δονήσεις, από τις οποίες προκλήθηκαν ζημιές στα κτίρια. Ετσι μπορούν να ερμηνευθούν τα ερείπια που δημιουργήθηκαν πριν από την εναπόθεση των ηφαιστειακών υλικών. Η ανυπαρξία σκελετών ανθρώπινων ή ζωικών κάτω από τα ερείπια αυτά μπορεί να ερμηνευθεί ως ένδειξη ότι των σεισμών προηγήθηκαν μικροδονήσεις που έδωσαν το μήνυμα στους κατοίκους της πόλης να την εκκενώσουν.

«Τους σεισμούς αυτούς ακολούθησε περίοδος ηρεμίας, αρκετής για να ενθαρρυνθούν οι κάτοικοι της πόλης να επιστρέψουν και να αρχίσουν εργασίες κατεδάφισης ετοιμόρροπων κτιρίων και καθαρισμού των δρόμων. Στη διάρκεια των εργασιών αυτών, φαίνεται πως άρχισε η διαδικασία της έκρηξης. Από τη στρωματογραφία των ηφαιστειακών υλικών που κάλυψαν ολόκληρο το νησί, προκύπτει ότι η έκρηξη του ηφαιστείου εκδηλώθηκε με σειρά παροξυσμών διαφορετικής κάθε φορά ισχύος. Εκκληση αερίων, ατμίδων και καπνού φαίνεται ότι προηγήθηκε ειδοποιώντας έτσι τους έμπειρους κατοίκους του νησιού για το κακό που έμελλε να ακολουθήσει. Αυτοί με τη σειρά τους έσπευσαν για δεύτερη φορά να εγκαταλείψουν την πόλη και να μην θαφτούν μέσα σ' αυτήν».



Εξαιρετικά ενδιαφέροντα είναι και τα στοιχεία που έχουν έρθει στο φως για την εξάπλωση της ηφαιστειακής τέφρας. Ερευνες που έχουν γίνει τόσο στον βυθό της Μεσογείου όσο και σε αρχαιολογικές ανασκαφές έχουν δείξει ότι η τέφρα παρασύρθηκε προς τα ανατολικά, καλύπτοντας την περιοχή από τη Σμύρνη έως την Ανατολική Κρήτη, με συγκέντρωση μεγαλύτερη στην περιοχή της Ρόδου. Μόρια θηραϊκής τέφρας εντοπίστηκαν εργαστηριακά στις ακτές της Ανατολικής Μεσογείου και στην περιοχή του Δέλτα του Νείλου.

(Σάκης Ιωαννίδης / Η ΚΑΘΗΜΕΡΙΝΗ, 09.11.2016, http://www.kathimerini.gr/882733/article/epikairothta/ellada/nea-dedomena-gia-to-tsoynami-ths-santorinhs)



Η καλδέρα θυμάται
Το χρονικό της καταστροφής από την έκρηξη της Θήρας

Η σημερινή Σαντορίνη είναι ό,τι απέμεινε από ένα μεγαλύτερο νησί μετά την κατάρρευση της καλδέρας του ηφαιστείου (Πηγή: Steve Jurvetson / CC BY-SA 2.0)

Το καταστροφικό τσουνάμι που σάρωσε το προϊστορικό Αιγαίο μετά την κατακλυσμική έκρηξη του ηφαιστείου της Σαντορίνης δεν προκλήθηκε από την ταυτόχρονη κατάρρευση των τοιχωμάτων της καλδέρας, όπως πίστευαν έως τώρα οι επιστήμονες, αλλά από την τεράστια ποσότητα πυροκλαστικών ηφαιστειακών υλικών που έπεσαν απότομα μέσα στη θάλασσα.

Αυτό προκύπτει από μία νέα έρευνα Ελλήνων και άλλων επιστημόνων, που δημοσιεύθηκε στην επιθεώρηση «Nature Communications», με επικεφαλής την Παρασκευή Νομικού, επίκουρη καθηγήτρια Φυσικής Γεωγραφίας και Γεωλογικής Ωκεανογραφίας του Τμήματος Γεωλογίας και Γεωπεριβάλλοντος του Πανεπιστημίου Αθηνών.

Τα στοιχεία

Οι επιστήμονες παρουσιάζουν νέα βαθυμετρικά και σεισμικά στοιχεία, τα οποία αποδεικνύουν ότι η καλδέρα δεν ήταν ανοιχτή προς τη θάλασσα κατά τη διάρκεια της κύριας φάσης της έκρηξης, αλλά πλημμύρισε με νερό, αφότου η έκρηξη είχε πια ολοκληρωθεί.

Η μέχρι σήμερα κυρίαρχη θεωρία ήταν ότι κατά την ηφαιστειακή έκρηξη, εξαιτίας της οποίας κατέρρευσε το ηφαιστειακό συγκρότημα στη θάλασσα, δημιουργήθηκε μία τεράστια καλδέρα, με διαστάσεις δέκα επί επτά χιλιομέτρων, και αυτή η κατάρρευση προκάλεσε τσουνάμι. Η νέα θεωρία αμφισβητεί τις έως τώρα εκτιμήσεις για το πώς προκλήθηκε το τσουνάμι.

Πώς μεγάλωσε και πλημμύρισε η προϋπάρχουσα καλδέρα

Οι πρόσφατες έρευνες της κ. Νομικού και των άλλων ερευνητών, που έγιναν στον βυθό γύρω από το νησί, έφεραν στο φως στα βορειοδυτικά της καλδέρας ένα υποθαλάσσιο κανάλι, πλάτους ενός χιλιομέτρου και μήκους τριών χιλιομέτρων, το οποίο συνέδεε την καλδέρα με τη θάλασσα. Αυτό το κανάλι, το οποίο αρχικά είχε κλείσει από την τέφρα και υλικά της έκρηξης, στη συνέχεια -όπως ένα φράγμα που σπάει- υποχώρησε ξαφνικά και έτσι η έως τότε σχεδόν στεγνή καλδέρα γέμισε με θαλασσινό νερό, μέσα σε λιγότερο από δύο ημέρες ή ακόμη και σε λίγες ώρες.

Όταν έγινε η ηφαιστειακή έκρηξη, σύμφωνα με τους επιστήμονες, υπήρχε ελάχιστο έως καθόλου νερό μέσα στην καλδέρα, η οποία ήταν απομονωμένη από τη γύρω θάλασσα. Προ της έκρηξης, στο βόρειο τμήμα του ηφαιστειακού πεδίου, η Σαντορίνη διέθετε, ήδη, μία ρηχή καλδέρα σαν λιμνοθάλασσα, που είχε δημιουργηθεί από προηγούμενη έκρηξη πριν από 18.000 χρόνια.

Η κατοπινή μεγάλη έκρηξη του 1610 πΧ βάθυνε και διεύρυνε εκείνη την αρχαιότερη καλδέρα, η οποία τελικά πλημμύρισε με νερό, όταν στη βορειοδυτική περιοχή μεταξύ Οίας-Θηρασίας, που έως τότε ήταν πάνω από το επίπεδο της θάλασσας, άνοιξε ένα κανάλι προς τη θάλασσα. Οι επιστήμονες υπολόγισαν ότι για να γίνει αυτό, εκτοπίσθηκαν από τα εισρέοντα νερά πετρώματα όγκου 2 έως 2,5 κυβικών χιλιομέτρων.

Αυτό το απότομο πλημμυρικό συμβάν, που έγινε με χρονική υστέρηση σε σχέση με την κυρίως έκρηξη, σταμάτησε όταν το νερό μέσα στην καλδέρα έφθασε στο επίπεδο της θάλασσας (κάτι ανάλογο συνέβη με την πλημμύρα που γέμισε με νερό τη Μαύρη Θάλασσα πριν περίπου 8.400 χρόνια). Λίγο μετά, τα νερά της θάλασσας άνοιξαν ακόμη δύο κανάλια στα νοτιοδυτικά της καλδέρας.

Όμως, ενώ αυτή η μαζική πλημμύρα προκάλεσε κύματα μέσα στην ίδια την καλδέρα, δεν θεωρείται ικανή να έχει προκαλέσει μεγάλα κύματα έξω από αυτήν. Συνεπώς, θεωρείται απίθανο να δημιούργησε τσουνάμι, μάλιστα, τόσο μεγάλης κλίμακας. Για να είχε δημιουργηθεί τσουνάμι κατά την κατάρρευση της καλδέρας, θα πρέπει αυτή να ήταν ήδη γεμάτη νερό και να συνδεόταν με την ανοιχτή θάλασσα. Κάτι τέτοιο, όμως, όπως δείχνει η νέα μελέτη, δεν συνέβαινε τότε, αλλά συνέβη αργότερα, καθώς η καλδέρα πλημμύρισε και συνδέθηκε με τη θάλασσα μόνο όταν πια είχε τελειώσει η έκρηξη του ηφαιστείου.

Τι προκάλεσε το τσουνάμι

Αντίθετα, οι ερευνητές εντόπισαν στον βυθό, στα ανοιχτά των ακτών της Σαντορίνης, εναποθέσεις πυροκλαστικών υλικών πάχους έως 60 μέτρων, τα οποία -κατά την έκρηξη του ηφαιστείου- εκτινάχθηκαν γρήγορα προς κάθε κατεύθυνση στη θάλασσα γύρω από το νησί. Αυτός ο μεγάλος όγκος των πυροκλαστικών ροών (της τάξης των 30 έως 80 κυβικών χιλιομέτρων) εκτιμάται ότι εκτόπισε, αντίστοιχα, μεγάλες ποσότητες νερού και ήταν ικανός να προκαλέσει το τσουνάμι.

Όπως δήλωσε στο Αθηναϊκό και Μακεδονικό Πρακτορείο Ειδήσεων η κ. Νομικού, «εδώ και χρόνια οι επιστήμονες μελετούν τη μορφολογία του ηφαιστείου της Σαντορίνης για να βρουν ποια τμήματά του καταποντίστηκαν και ποια έμειναν στην επιφάνεια μετά την έκρηξη. Η νέα μελέτη μας δείχνει ότι υπήρχε ένα κανάλι μεταξύ Οίας και Θηρασιάς, το οποίο μπαζώθηκε από την έκρηξη και έτσι η κύρια καλδέρα γκρεμίστηκε χωρίς να προκαλέσει τσουνάμι. Στη συνέχεια, όταν έσπασε το φράγμα στο κανάλι μεταξύ Οίας-Θηρασιάς, εισχώρησε το θαλασσινό νερό στην καλδέρα το πολύ μέσα σε δύο ημέρες».

«Κάτι τέτοιο, όμως, δεν προκάλεσε το τσουνάμι. Αυτό δημιουργήθηκε, επειδή κατά την τρίτη και την τέταρτη φάση της έκρηξης εκτινάχθηκαν στον αέρα μεγάλες ποσότητες ηφαιστειακής τέφρας, πυροκλαστικές ροές που στη συνέχεια εισχώρησαν στον υποθαλάσσιο χώρο. Αυτές τελικά προκάλεσαν το τσουνάμι, το οποίο επηρέασε τη βόρεια Κρήτη και όλη την ανατολική Μεσόγειο», πρόσθεσε η Ελληνίδα επιστήμονας.

Κύματα ύψους, τουλάχιστον, εννέα μέτρων έφθασαν στη βόρεια Κρήτη και πλημμύρισαν διάφορες περιοχές, όπως δείχνουν ευρήματα σε μινωικές αρχαιολογικές τοποθεσίες, όπως το Παλαιόκαστρο. Αυτή η νέα θεωρία είναι σύμφωνη με υπάρχουσες μελέτες, που αποδεικνύουν ότι οι πυροκλαστικές ροές ήταν, επίσης, η κύρια αιτία για το τσουνάμι που προκλήθηκε κατά την ισχυρή έκρηξη του ηφαιστείου Κρακατόα της Ινδονησίας το 1883.

Πλήγμα στους Μινωίτες, αλλά όχι κατάρρευση

Η έκρηξη του ηφαιστείου της Σαντορίνης κατά την Ύστερη Εποχή του Χαλκού ήταν μία από τις μεγαλύτερες των τελευταίων 10.000 ετών σε όλον τον κόσμο. Η επικρατέστερη επιστημονική εκτίμηση είναι ότι η έκρηξη του ηφαιστείου της Θήρας έγινε περίπου το 1610 πΧ (συν/πλην 15 χρόνια).

Ο Μινωικός Πολιτισμός στην Κρήτη καταστράφηκε πολύ αργότερα, περί το 1450 πΧ. Συνεπώς, σύμφωνα με την κ. Νομικού, η έκρηξη του ηφαιστείου και το επακόλουθο τσουνάμι αποτέλεσε μεν ένα πλήγμα που κατέστησε πιο ευάλωτο τον πολιτισμό των Μινωιτών, αλλά ο τελευταίος κατέρρευσε από άλλες ενδογενείς αιτίες, τουλάχιστον ενάμιση αιώνα αργότερα.

Στη νέα μελέτη συμμετείχαν, από ελληνικής πλευράς, ο καθηγητής Δημήτρης Παπανικολάου και η Δανάη Λαμπρίδου του Τμήματος Γεωλογίας του Πανεπιστημίου Αθηνών, καθώς, επίσης, επιστήμονες από τη Γαλλία, τη Βρετανία, τη Γερμανία, τις ΗΠΑ και την Ισλανδία.

(Newsroom ΔΟΛ, με πληροφορίες από ΑΠΕ-ΜΠΕ, 09 Νοε 2016, http://news.in.gr/science-technology/article/?aid=1500113644&ref=newsletter)

'Invisibility cloaks' for buildings could protect them from earthquakes

Researchers are developing large structures inspired by 'cloaking' materials for sound and light, which can offer protection against seismic waves.

Earthquakes travel in waves, much as sound and light do. Scientists have previously designed materials with internal structures that interfere with the propagation of sound and light, and now researchers are working on making bigger versions of these structures, which could be used to control the propagation of earthquakes.

Scientists have tried this by digging cylindrical pits at regular intervals in the soil. This ordered arrangement of boreholes scatters incoming destructive surface waves, causing them to interfere with each other and cancel out.

> Wouldn't it be great if we could surround a historic castle or a nuclear power station with a metamaterial, so that when the seismic waves come at it they are sent around or diverted into the ground.
>
> ***Professor Richard Craster***

However, while the ground within the pattern is protected, the reflection of incoming waves causes greater destruction to the surrounding area. In addition, earthquakes produce very long wavelengths—so long that they could bypass the borehole shield without ever interacting with it.

Now, mathematicians at Imperial College London, with collaborators in France, are trying a different approach: using trees. Trees act as resonators, which osciallate at certain frequencies, even at long wavelengths. In the right arrangement, the interaction of resonating trees can redirect the energy of seismic waves deep into the soil, reducing damage.

This approach is based on metamaterials, artificial arrangements of resonators with unusual electromagnetic properties. Metamaterial 'invisibility cloaks' have already been used to make very small objects invisible to the eye by redirecting light waves. Now, large-scale versions could be created to emulate the resonance of trees and make buildings 'invisible' to earthquakes.

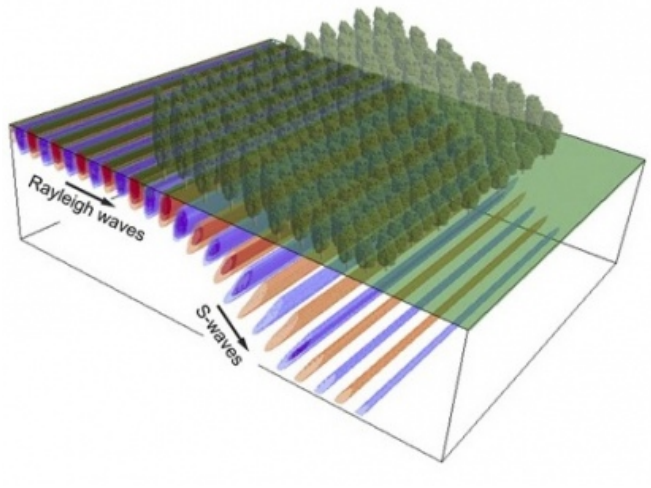
DIVERTING EARTHQUAKES

Professor Richard Craster, Head of the Department of Mathematics at Imperial, is part of the team looking into this phenomenon. "Wouldn't it be great if we could surround a historic castle or a nuclear power station with a metamaterial, so that when the seismic waves come at it they are sent around or diverted into the ground. The building would remain perfectly still, not damaged. This is what we want to do," he said.

Earlier this year, Dr Andrea Colombi, also from Imperial, with Professor Craster and collaborators in France, demonstrated that a dense forest behaves as a natural seismic metamaterial. By generating vibrations from a crane and measuring the effects with seismometers, they found that the resonating trees offer local protection against surface waves of certain frequencies.

In a natural forest, the researchers noted that the irregular height of trees and of the gaps between them offered protection against a larger range of frequencies than a uniform array would. If the trees are arranged by decreasing height, they would cover an even wider range of seismic frequencies.

Scientists call this a 'metawedge', which could eventually be created with real trees or poles acting as artificial resonators. Metawedges can only deal effectively with waves coming from two directions, but the researchers are hopeful they can find solutions to this.



Artist view of a 'metawedge' of trees affecting the movement of earthquake waves

METAMATERIAL BARRIERS

There are also other potential applications for metawedges, for example using them to mask other kinds of vibrational waves that can impact buildings.

"Another thing we care about is, for example, the vibration coming from railway lines," said Professor Craster. "We could put a metamaterial barrier between the train and the houses, so that the waves went down into the Earth or somewhere where we can dampen them."

Seismic metamaterials have attracted the greatest enthusiasm among those looking for solutions to earthquake damage. Researchers in Italy are conducting similar experiments, with the resonators buried in the ground instead of thrusting out of it.

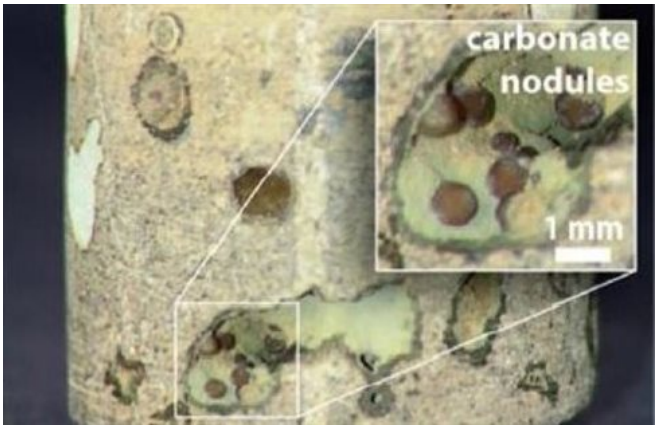
Professor Craster and his colleagues are also looking at how a system using boreholes could be made more effective. The team are patenting a version of this system that they claim will work even at seismic wavelengths.

"In some parts of the world there are very small scale but quite regular earthquakes," he said. "Over the years this causes cracking in the houses. If you know where the waves typically come from you can condition the soil near those houses by putting down an array of boreholes, and they would simply reflect off into a field somewhere. Insurance companies would pay for this, the people in the houses might pay for this. I think engineering companies will be looking into this sort of thing."

(Bruno Martin / Imperial College Alumni e-Bulletin December 2016, 21 November 2016, http://www3.imperial.ac.uk/newsandeventspggrp/imperialcollege/newssummary/news_21-11-2016-11-50-17?utm_source=alumni-bulletin&utm_medium=email&utm_campaign=alumniebulletin)

ΕΝΔΙΑΦΕΡΟΝΤΑ - ΠΕΡΙΒΑΛΛΟΝ

Λύση για το κλίμα
Πείραμα μετατροπής του CO_2 σε πέτρα δείχνει να πέτυχε



Η εξέταση των δειγμάτων από το υπέδαφος επιβεβαίωσε ότι το CO_2 είχε μετατραπεί σε ανθρακικά άλατα (Πηγή: American Chemical Society)

Αν η ανθρωπότητα θέλει να συγκρατήσει την κλιματική αλλαγή σε υποφερτά επίπεδα, οι τεχνολογίες μόνιμης αποθήκευσης του διοξειδίου του άνθρακα θα πρέπει σχεδόν σίγουρα να είναι μέρος της λύσης. Τώρα, ερευνητές στις ΗΠΑ αναφέρουν ότι το CO_2 που διοχετεύεται σε βασαλτικά πετρώματα στο υπέδαφος μεταμορφώνεται σχετικά γρήγορα σε πέτρα.

Εργαστηριακές μελέτες έχουν δείξει ότι ο βασάλτης, ένα πέτρωμα που δημιουργείται από τη στερεοποίηση της λάβας, δεσμεύει το διοξείδιο του άνθρακα και σταδιακά το μετατρέπει σε στερεά ανθρακικά άλατα, τα οποία δεν μπορούν να δραπετεύσουν από το υπέδαφος.

Κανείς όμως δεν μπορούσε να είναι βέβαιος ότι τα ευρήματα στο εργαστήριο ανακλούν αυτό που συμβαίνει σε πραγματικές συνθήκες.

Για να το διαπιστώσουν, ερευνητές του Pacific Northwest National Laboratory, σε συνεργασία με την αμερικανική κοινοπραξία Big Sky Carbon Sequestering Partnership, ξεκίνησαν ένα μεγάλο πείραμα το 2009, στο οποίο 1.000 τόνοι υγρού διοξειδίου του άνθρακα διοχετεύτηκαν υπό πίεση σε μια γεώτρηση στη λεκάνη του ποταμού Κολούμπια.

Δύο χρόνια αργότερα, δείγματα συλλέχθηκαν από το υπέδαφος και στάλθηκαν για ανάλυση. Πράγματι, το CO_2 είχε μετατραπεί σε ένα ανθρακικό ορυκτό που ονομάζεται αγκερίτης και έχει τη χημική φόρμουλα $Ca(Fe,Mg,Mn)(CO_3)_2$.

Δεδομένου ότι βασαλτικοί σχηματισμοί είναι ευρέως κατανεμημένα στη Βόρειο Αμερική και τον υπόλοιπο πλανήτη, η τεχνολογία στερεοποίησης του CO_2 θα μπορούσε να εφαρμοστεί σε μεγάλη κλίμακα, προτείνουν οι ερευνητές παρουσιάζοντας τα ευρήματα στην επιθεώρηση Environmental Science & Technology Letters[(1)].

Εξίσου ενθαρρυντικά αποτελέσματα, εξάλλου, είχε δώσει και ένα παρόμοιο πείραμα στην Ισλανδία, του οποίου τα αποτελέσματα δημοσιεύτηκαν φέτος στο Science[(2)].

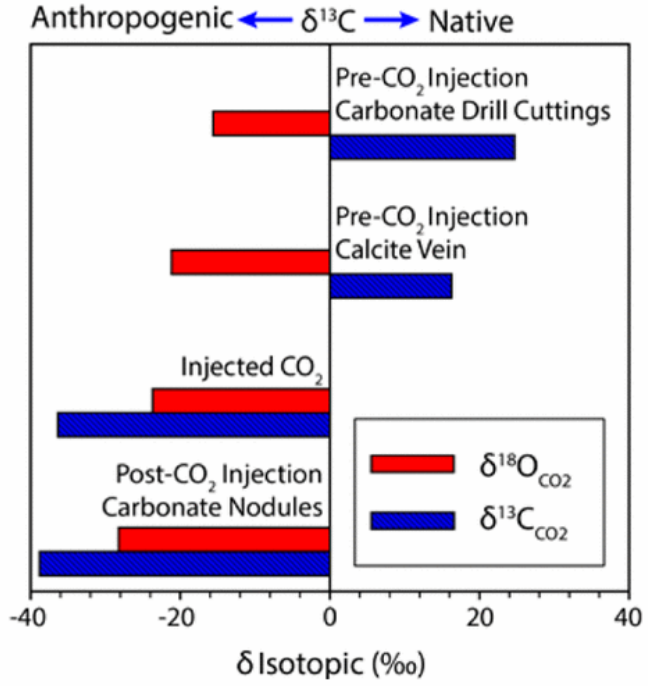
(Βαγγέλης Πρατικάκης / Newsroom ΔΟΛ, 21 Νοε. 2016, http://news.in.gr/science-technology/article/?aid=1500116055)

[(1)] Field Validation of Supercritical CO_2 Reactivity with Basalts

B. Peter McGrail*, Herbert T. Schaef, Frank A. Spane, John B. Cliff, Odeta Qafoku, Jake A. Horner, Christopher J. Thompson, Antoinette T. Owen, and Charlotte E. Sullivan

Abstract

Continued global use of fossil fuels places a premium on developing technology solutions to minimize increases in atmospheric CO_2 levels. CO_2 storage in reactive basalts might be one of these solutions by permanently converting injected gaseous CO_2 into solid carbonates. Herein, we report results from a field demonstration in which ~1000 metric tons of CO_2 was injected into a natural basalt formation in eastern Washington state. Following post-injection monitoring for 2 years, cores were obtained from within the injection zone and subjected to detailed physical and chemical analysis. Nodules found in vesicles throughout the cores were identified as the carbonate mineral, ankerite $Ca[Fe,Mg,Mn](CO_3)_2$. Carbon isotope analysis showed the nodules are chemically distinct compared with natural carbonates present in the basalt and in clear correlation with the isotopic signature of the injected CO_2. These findings provide field validation of rapid mineralization rates observed from years of laboratory testing with basalts.



Environ. Sci. Technol. Lett., **2017**, *4* (1), pp 6–10, **DOI:** 10.1021/acs.estlett.6b00387, November 18, 2016

*E-mail: pete.mcgrail@pnnl.gov.

http://pubs.acs.org/doi/abs/10.1021/acs.estlett.6b00387

[(2)]Η Ισλανδία δίνει το παράδειγμα
Μετατροπή του CO_2 σε ασβεστόλιθο υπόσχεται να σώσει στο κλίμα

Επιστήμονες και μηχανικοί που εργάζονται σε μεγάλο σταθμό παραγωγής ενέργειας στην Ισλανδία βρήκαν έναν έξυπνο τρόπο να αφαιρούν το διοξείδιο του άνθρακα από την ατμόσφαιρα, μετατρέποντας το σε... πέτρα. Με αυτό τον πρωτότυπο τρόπο συμβάλλουν στη μείωση των ανθρωπογενών αερίων του θερμοκηπίου και στη συγκράτηση της κλιματικής αλλαγής.

ΟΙ χημικές αντιδράσεις μετέτρεψαν το CO2 σε στερεές ανθρακικές ενώσεις, οι οποίες διακρίνονται εδώ ως υπόλευκες αποθέσεις (Πηγή: Lamont-Doherty Earth Observatory)

Ερευνητές από διάφορες χώρες (Βρετανία, ΗΠΑ, Γαλλία, Ισλανδία), με επικεφαλής τον αναπληρωτή καθηγητή γεωμηχανικής Γιούεργκ Μάτερ του βρετανικού Πανεπιστημίου του Σαουθάμπτον απέδειξαν ότι είναι δυνατόν να διοχετεύσουν -μαζί με νερό- τις εκπομπές διοξειδίου μέσα στη γη, όπου στερεοποιούνται και μετατρέπονται σε ασβεστόλιθο μέσα σε μερικούς μήνες έως δύο χρόνια, πολύ πιο γρήγορα από τις έως τώρα εκτιμήσεις ότι κάτι τέτοιο θα χρειαζόταν εκατοντάδες ή και χιλιάδες χρόνια.

Η τεχνική αυτή διαλύει τους φόβους ότι το διοξείδιο που διοχετεύεται στο υπέδαφος θα μπορούσε κάποια στιγμή να δραπετεύσει (π.χ. λόγω σεισμών) και να επανέλθει στην ατμόσφαιρα ή, ακόμη χειρότερα, να προκαλέσει υπόγεια έκρηξη. Από τη στιγμή που γίνεται πέτρωμα, όλα αυτά δεν ισχύουν.

Το ισλανδικό εργοστάσιο Χελισέιντι είναι η μεγαλύτερη στον κόσμο γεωθερμική μονάδα ηλεκτροπαραγωγής, τροφοδοτώντας με ενέργεια την πρωτεύουσα Ρέικιαβικ. Ο σταθμός χρησιμοποιεί ζεστό νερό από το υπέδαφος για να παράγει ηλεκτρισμό, αλλά η διαδικασία φέρνει στην επιφάνεια ηφαιστειακά αέρια, μεταξύ των οποίων διοξείδιο του άνθρακα. Η νέα τεχνική με την ονομασία CarbFix επιστρέφει το διοξείδιο στο υπέδαφος και το κλειδώνει εκεί για τα καλά.

«Από τους 220 τόνους διοξειδίου που διοχετεύσαμε στο υπέδαφος, το 95% έως 98% έγινε ορυκτό σε περίοδο μικρότερη των δύο ετών, δηλαδή εντυπωσιακά γρήγορα. Πρόκειται για μια μόνιμη και περιβαλλοντικά φιλική μέθοδο αποθήκευσης των εκπομπών του διοξειδίου, η οποία διασφαλίζει ότι δεν θα υπάρξει ξανά διαρροή τους στην επιφάνεια» δήλωσε ο Μάτερ.

Το επίτευγμα δημοσιεύεται στην επιθεώρηση «Science».

Ηφαιστειακή επαφή

Το αέριο διαλύεται σε νερό και διοχετεύεται σε ένα βαθύ πηγάδι κάτω από το εργοστάσιο. Ερχόμενο σε επαφή με τα βασαλτικά ηφαιστειακά πετρώματα σε βάθος 400 έως 800 μέτρων, μέσα από μια σειρά φυσικών γεωχημικών αντιδράσεων, μετατρέπεται σε υπόλευκο ανθρακικό ορυκτό, ένα είδος ασβεστόλιθου.

«Μπορούμε πλέον να διοχετεύουμε μεγάλες ποσότητες διοξειδίου και να το αποθηκεύουμε με πολύ ασφαλή τρόπο στο υπέδαφος και μάλιστα σε πολύ σύντομο χρόνο. Στο μέλλον θα μπορούσαμε να χρησιμοποιήσουμε αυτή την μέθοδο σε μονάδες ηλεκτροπαραγωγής όπου υπάρχει πολύς βασάλτης από κάτω τους - και υπάρχουν πολλά τέτοια μέρη» δήλωσε ο υδρολόγος Μάρτιον Στούτε του Γεωπαρατηρητηρίου Λάμοντ-Ντόχερτι του Πανεπιστημίου Κολούμπια της Νέας Υόρκης.

«Μπορεί κανείς να βρει βασάλτες σε κάθε ήπειρο και ασφαλώς σε υπεράκτιες περιοχές, επειδή όλος ο ωκεάνιος φλοιός είναι βασαλτικά πετρώματα. Συνεπώς από άποψη διαθέσιμων βασαλτικών πετρωμάτων για να διοχετεύσουμε τις εκπομπές του διοξειδίου, δεν υπάρχει κανένα πρόβλημα» πρόσθεσε ο Μάτερ. Εκτός από σχεδόν όλους τους βυθούς, περίπου το 10% των επιφανειακών πετρωμάτων της Γης είναι βασαλτικά.

Το κόστος

Υπάρχει όμως το ζήτημα του όχι αμελητέου κόστους της μεθόδου και οι μεγάλες νερού που απαιτεί, καθώς μόνο το 4% έως 5% του διαλύματος που στέλνεται στο υπέδαφος, είναι διοξείδιο του άνθρακα (χρειάζονται περίπου 25 τόνοι νερού για κάθε τόνο διοξειδίου).

Μετά την αρχική πειραματική φάση που άρχισε το 2012, το ισλανδικό εργοστάσιο ηλεκτροπαραγωγής Χελισέιντι της εταιρείας Reykjiavik Energy έχει ήδη αρχίσει να εφαρμόζει σε ευρύτερη κλίμακα την μέθοδο, στέλνοντας έως 5.000 τόνους διοξειδίου του άνθρακα ετησίως να αποθηκεύονται στο βασαλτικό υπέδαφος, ενώ σχεδιάζει να διπλασιάσει την ποσότητα φέτος το καλοκαίρι. «Θάβει» επίσης ένα άλλο υποπροϊόν της γεωθερμίας, το υδρόθειο, κάτι ευπρόσδεκτο για τους περιοίκους, οι οποίοι έπρεπε να μυρίζουν την καθόλου ευχάριστη οσμή των κλούβιων αβγών.

Και ένα υστερόγραφο από τη Φύση: στο υπέδαφος υπάρχουν μικρόβια που τρώνε ανθρακικά ορυκτά και απελευθερώνουν μεθάνιο, ένα ακόμη πιο ισχυρό αέριο του θερμοκηπίου σε σχέση με το διοξείδιο του άνθρακα.

(Newsroom ΔΟΛ, με πληροφορίες από ΑΠΕ-ΜΠΕ, 10 Ιουν. 2016, http://news.in.gr/science-technology/article/?aid=1500083357)

ΕΝΔΙΑΦΕΡΟΝΤΑ - ΛΟΙΠΑ

16 giant infrastructure projects that could reshape the world

The world is full of inconceivably huge projects happening right under our noses.

Take the Hong Kong-Zhuhai-Macau Bridge, which will link three major Chinese cities in the country's quest to bring 42 million people together. Or Norway's plan to build the world's first fully-submerged floating tunnel to cut travel times between fjords in half.

Those efforts and many others illustrate how investing billions of dollars in enormous projects can collectively make the world a better place to live.

Here are some of the biggest projects the world has seen so far.

Completed in September 2016, **China's Pingtang telescope** is now the world's largest radio telescope. Its dish measures 1,640 feet across and is capable of capturing signals more than 1,000 light-years from Earth.

After 17 years of construction, the **Gotthard Base Tunnel** opened in Switzerland on June 1, 2016. At 35 miles long, it's both the longest and deepest train tunnel in the world,

offering unprecedented efficiency when traveling through the Alps.

The newly expanded **Panama Canal** was unveiled to the public in early June, 102 years after it first opened. It took $5.4 billion and 40,000 workers to triple the capacity of the waterway.

In 2026, an Iraqi skyscraper known as "**The Bride**" will feature a "veil" of solar panels and produce as much energy as it consumes. It'll be 3,779 feet tall and contain parks, offices, restaurants, and a rail system.

Completed in 2011, China's Jiaozhou Bay Bridge is the world's longest cross-sea bridge, stretching nearly 26 miles — almost the length of a marathon. It cut travel time in half for people going between east China and the island of Huangdao.

In 2015, the **Itaipu Dam** on the border of Brazil and Paraguay generated 89.5 Twh of energy, the most of any dam in the world. It supplies 75% of Paraguay's total energy and nearly 20% of Brazil's.

London's Crossrail project — a massive upgrade to the existing Underground system — is the largest construction project ever undertaken in Europe. It involves 10 new train lines and connects 30 existing stations via brand-new tunnels. It will begin service in 2017, and be fully operational by 2020.

The **Hyderabad Metro Rail** is a 46-mile-long light rail system that will finally bring communication-based train control to India. It's due to be completed in 2017.

The Hong Kong-Zhuhai-Macau Bridge project will link three cities in China's Pearl River Delta — creating one mega-city of 42 million people — when it's completed in 2017.

Dubai's Mall of the World will be a colossal domed structure nine times bigger than the Mall of America. When it opens in 2029, it will be temperature-controlled, feature thousands of hotel rooms, and have its own transit line.

Google's parent company, Alphabet Inc., is developing plans to create "**Smart Cities**" — redeveloped areas with complete Internet access, renewable energy, and the latest in automated technology — throughout the US.

The **Riyadh Metro, Saudi Arabia**'s new $23.5 billion rail line will boast a station designed by Zaha Hadid. Its 109 miles of railway will revolutionize how residents of Riyadh get around. It's set to begin operation by 2019.

Songdo, South Korea is a so-called "smart city" located on 1,500 acres of waterfront land. Completed in 2015, Songdo's near-comprehensive Internet access gives its 67,000 residents a taste of future society.

The South–North Water Transfer Project is an ongoing Chinese effort to move nearly 45 billion cubic feet of water from the Yangtze River to the country's less fertile northern regions. More than $79 billion has been spent on the migration so far.

In July of 2016, Norway announced plans to spend a reported $25 billion on a **fully submerged, floating tunnel beneath the Sognefjord**, a body of water more than 4,000 feet deep and 3,000 feet wide. It would be the first of its kind in the world.

The 20-year Turkey Urban Renewal Project, a far-reaching plan to demolish some 7 million buildings and rebuild earthquake-resistant structures in their place, began in 2012 with an estimated cost of $400 billion.

(Chris Weller / Nov. 7, 2016, http://www.businessinsider.com/giant-infrastructure-projects-around-the-world-2016-11/#completed-in-september-2016-chinas-pingtang-telescope-is-now-the-worlds-largest-radio-telescope-its-dish-measures-1640-feet-across-and-is-capable-of-capturing-signals-more-than-1000-light-years-from-earth-1)

Δρόμοι για γερά στομάχια

1. Passo dello Stelvio, Ιταλία

Το πέρασμα Stelvio στις Ανατολικές Αλπεις δημιουργήθηκε μεταξύ 1820 και 1825 επί αυστριακής αυτοκρατορίας, για να συνδέσει την τότε αυστριακή επαρχία της Λομβαρδίας με την υπόλοιπη Αυστρία. Η διαδρομή λίγο έχει αλλάξει μέχρι σήμερα και εξακολουθεί να προκαλεί τρόμο στους οδηγούς που δεν είναι εξοικειωμένοι με τις 48 ελικοειδείς στροφές, σε υψόμετρο 2.757 μ., την απότομη κλίση του οδοστρώματος, που σε ορισμένα σημεία στενεύει απρόσμενα πολύ, και την ολισθηρότητα εξαιτίας του χιονιού, που κάποιες φορές επιμένει μέχρι και τον Ιούλιο. Αν και έχει στοιχίσει τη ζωή σε πολύ κόσμο, το πέρασμα συγκαταλέγεται στα ωραιότερα της Ευρώπης, ενώ η ανάβαση των ποδηλατών στον Γύρο της

Ιταλίας αποτελεί από τις πιο συναρπαστικές και συγκινητικές στιγμές του αγώνα.

2. Zoji La Pass, Ινδία

Για τους κατοίκους του χωριού Ladakh, στην Ινδία, το πέρασμα Zoji La είναι η μοναδική δίοδος επικοινωνίας με τον υπόλοιπο κόσμο. Οι οδηγοί για να διασχίσουν τον χωματόδρομο –εννοείται μονής κατεύθυνσης–, πρέπει όχι μόνο να αντιμετωπίσουν τα έντονα καιρικά φαινόμενα που εκδηλώνονται σε υψόμετρο 3.528 μ., αλλά και για εννέα ολόκληρα χιλιόμετρα να «φλερτάρουν» με το τρομακτικό κενό. Η θέα των βουνοκορφών, των κοιλάδων και της οργιώδους κατά τόπους βλάστησης μπορεί εύκολα να παρασύρει το βλέμμα του ανυποψίαστου επισκέπτη, ο δρόμος όμως δεν ενδείκνυται για χάζεμα.

3. James Dalton Highway, Αλάσκα

Στην Αλάσκα οι δρόμοι παραμένουν παγωμένοι τους περισσότερους μήνες του χρόνου, δυσκολεύοντας την οδήγηση, παρά το χαλίκι με το οποίο στρώνονται για μεγαλύτερη πρόσφυση των οχημάτων. Ο αυτοκινητόδρομος James Dalton όχι μόνο δεν αποτελεί εξαίρεση, αλλά συνιστά και κατηγορία από μόνος του, καθώς απευθύνεται σε επιδέξιους οδηγούς με μεγάλη ετοιμότητα. Δεν είναι μόνο η ολισθηρότητα στις απότομες στροφές που πρέπει να αντιμετωπίσουν ή τα χαλίκια που εξακοντίζονται στα παράθυρα, ούτε ακόμα οι λακκούβες μεγέθους κρατήρα, είναι οι ισχυροί άνεμοι, το πολικό ψύχος και η ίδια η ερημιά. Σε μια διαδρομή 666 χλμ. μόνο τρία χωριουδάκια συναντά κανείς. Ούτε πρατήρια βενζίνης, ούτε εστιατόρια, ούτε ξενοδοχεία. Για όσους επιθυμούν λίγη ενδοσκόπηση, αυτό είναι το απόλυτο road trip.

4. El Camino a los Yungas, Βολιβία

Τον αποκαλούν «δρόμο του θανάτου» και θεωρείται ο πιο επικίνδυνος στον κόσμο – στοιχίζει τη ζωή περίπου σε 300 ανθρώπους κάθε χρόνο. Πρόκειται για τον χωματόδρομο Γιούνγας, μήκους 69 χλμ., που συνδέει την πρωτεύουσα Λα Πας της Βολιβίας με το χωριό Κορόικο στην περιοχή Γιούνγας, κατηφορίζοντας από τα 4.650 μ. στα 1.200 μ. Εχει πλάτος όσο ένα αυτοκίνητο και κανενός είδους προστατευτικό κιγκλίδωμα από γκρεμούς που φτάνουν τα 600 μ. βάθος. Τα πράγματα γίνονται πιο επικίνδυνα με τις τροπικές βροχές, οι οποίες μετατρέπουν τον δρόμο σε ολισθηρό λασπότοπο, τις πτώσεις βράχων, την ομίχλη και, εννοείται, με την εμφάνιση δεύτερου οχήματος από την αντίθετη κατεύθυνση. Μήπως να διαλέξει κανείς τον καινούργιο δρόμο;

5. Guoliang Tunnel Road, Κίνα

Ενα από τα πιο δημοφιλή τούνελ στον κόσμο, το Guoliang στα όρη Taihang της Κίνας, έχει μήκος μόνο 1,2 χλμ., ύψος 5 μ. και πλάτος 4 μ., και μοιάζει περισσότερο με λαγούμι που σκάφτηκε με το χέρι. Για την ακρίβεια, σκάφτηκε με σφυρί και καλέμι το 1977 από τους κατοίκους του απομονωμένου χωριού Guoliang, οι οποίοι μέχρι τότε έφταναν στον έξω κόσμο μέσω ενός δύσβατου μονοπατιού χαραγμένου στον βράχο, με μια τεράστια χαράδρα να χάσκει από κάτω τους. Το τούνελ ανοίχτηκε στην άκρη του ίδιου βράχου, με 30 «παράθυρα» κατά μήκος της διαδρομής για να πετούν τα μπάζα. Το αποτέλεσμα εντυπωσιακό, αλλά επικίνδυνο για τον απρόσεκτο οδηγό, εξαιτίας της στενότητας και της έλλειψης ορατότητας στις στροφές.

6. Karakoram Highway, Πακιστάν

Σε υψόμετρο 4.693 μ., ο αυτοκινητόδρομος 1.300 χλμ. Karakoram ή το «όγδοο θαύμα» της μηχανικής, όπως τον έχουν αποκαλέσει εξαιτίας των δυσκολιών στην κατασκευή του, διασχίζει την ομώνυμη οροσειρά Karakoram, ενώνοντας τη Δυτική Κίνα με το Πακιστάν, και ακολουθεί ένα από τα πολλά μονοπάτια του αρχαίου «δρόμου του μεταξιού». Πραγματική πρόκληση για τους οδηγούς, με τις στενές, απότομες στροφές του να αναγκάζουν τους οδηγούς να ισορροπήσουν τα αυτοκίνητα στο χείλος του γκρεμού, είναι ιδιαίτερα επικίνδυνος την εποχή των μουσώνων λόγω των συχνών κατολισθήσεων και τον χειμώνα λόγω των χιονοπτώσεων. Παραμένει, ωστόσο, εντυπωσιακός και ιδιαίτερα αγαπητός στους λάτρεις των αλπικών τοπίων και της περιπέτειας.

(Μαρία Κωβαίου / Η ΚΑΘΗΜΕΡΙΝΗ, 08.11.2016, http://www.kathimerini.gr/881993/gallery/ta3idia/me-aformh/dromoi-gia-gera-stomaxia)

Μια «Όπερα» από το μέλλον

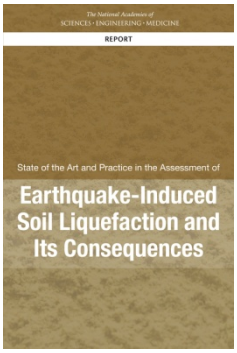
Με έμφαση στους ανοιχτούς δημόσιους χώρους για όλους τους επισκέπτες –και όχι μόνο σε όσους εισέρχονται για να παρακολουθήσουν μια εκδήλωση– και μια αρχιτεκτονική που «ρέει» μέσα στο τοπίο, το αρχιτεκτονικό γραφείο MAD σχεδίασε το κτίριο της Οπερας στην κινεζική πόλη Χαρμπίν με λείες επιφάνειες, που συνεχίζονται από το εξωτερικό στο εσωτερικό, και υλικά που αντανακλούν το φως και δημιουργούν αντικατοπτρισμούς της βαλτώδους γης που το περιβάλλει πάνω στις επιφάνειές του.

«Αντιμετωπίζουμε την αρχιτεκτονική ως τοπίο και θέλαμε να αποδώσουμε το άγριο και ψυχρό κλίμα των πόλεων του Βορρά. Οραματιστήκαμε όμως την Οπερα σαν ένα πολιτιστικό κέντρο που θα ενταχθεί στην ταυτότητα της πόλης και στην καθημερινότητα των ανθρώπων της», αναφέρει ο Ma Yansong, founding principal των MAD.

Οι εντυπωσιακές καμπύλες της οροφής οριοθετούν στο εσωτερικό τις δύο αίθουσες εκδηλώσεων, το τεράστιο lobby, καθώς και τους κοινόχρηστους χώρους, τις σκάλες κ.λπ., ενώ τα «νερά» πάνω στα ξύλα από την περιοχή της Μαντζουρίας, που έχουν επενδύσει μεγάλο μέρος του εσωτερικού, δημιουργούν ένα φυσικό ανάγλυφο που συνομιλεί με το τοπίο.

(Παγώνα Λαψατη / Η ΚΑΘΗΜΕΡΙΝΗ, 14.11.2016, http://www.kathimerini.gr/882999/article/ta3idia/ta3idiwtika-nea/mia-opera-apo-to-mellon)

ΝΕΕΣ ΕΚΔΟΣΕΙΣ ΣΤΙΣ ΓΕΩΤΕΧΝΙΚΕΣ ΕΠΙΣΤΗΜΕΣ



State of the Art and Practice in the Assessment of Earthquake-Induced Soil Liquefaction and Its Consequences

National Academies of Sciences, Engineering, and Medicine

Earthquake-induced soil liquefaction (liquefaction) is a leading cause of earthquake damage worldwide. Liquefaction is often described in the literature as the phenomena of seismic generation of excess porewater pressures and consequent softening of granular soils. Many regions in the United States have been witness to liquefaction and its consequences, not just those in the west that people associate with earthquake hazards.

Past damage and destruction caused by liquefaction underline the importance of accurate assessments of where liquefaction is likely and of what the consequences of liquefaction may be. Such assessments are needed to protect life and safety and to mitigate economic, environmental, and societal impacts of liquefaction in a cost-effective manner. Assessment methods exist, but methods to assess the potential for liquefaction triggering are more mature than are those to predict liquefaction consequences, and the earthquake engineering community wrestles with the differences among the various assessment methods for both liquefaction triggering and consequences.

State of the Art and Practice in the Assessment of Earthquake-Induced Soil Liquefaction and Its Consequences evaluates these various methods, focusing on those developed within the past 20 years, and recommends strategies to minimize uncertainties in the short term and to develop improved methods to assess liquefaction and its consequences in the long term. This report represents a first attempt within the geotechnical earthquake engineering community to consider, in such a manner, the various methods to assess liquefaction consequences.

https://www.nap.edu/catalog/23474/state-of-the-art-and-practice-in-the-assessment-of-earthquake-induced-soil-liquefaction-and-its-consequences

(National Academies of Sciences, Engineering, and Medicine, 2016)

ICE Specification for Piling and Embedded Retaining Walls, Third edition

The *ICE Specification for Piling and Embedded Retaining Walls* (SPER-Wall) is the UK's pre-eminent technical specification for piling and embedded walling works, either on land or near to shore.

The existence of an agreed way of executing piling works helps to reduce disputes on site and enables consultants to design more economically by having confidence in how the site works will be carried out. This edition has been updated to reflect the latest piling techniques and procurement methods used in the geotechnical sector, as well as revisions to the Eurocodes, British Standards and CIRIA guides.

This document has been designed for use with common practices, but is not intended to inhibit innovation. Novel solutions can be used with this specification provided that additional clauses are included in the project specification which will ensure that the final product is constructed in accordance with the design requirements.

ICE Specification for Piling and Embedded Retaining Walls:

- includes new sections on micropiling and helical piling as well as guidance on the use of polymer fluids for excavation support
- ensures tolerances are better understood for the various techniques
- provides further guidance on concrete specification and testing

This edition retains the three-part approach of the second edition. Part A is an introduction to the essential concepts necessary to procure a piling or retaining wall contract. Part B is the specification and is still the only part of this document intended for incorporation in contracts. Part C provides guidance for use of the specification and essential background information for specifiers and contractors alike.

This specification has been one of the most popular of ICE's standard specifications and has been fundamental in raising piling standards in the UK, as well as where it has been applied around the world.

(Institution of Civil Engineers, 2016)

Γεωλογία των Σεισμών Εισαγωγή στη Νεοτεκτονική, Μορφοτεκτονική, Παλαιοσεισμολογία και Αρχαιοσεισμολογία (Β΄ έκδοση)

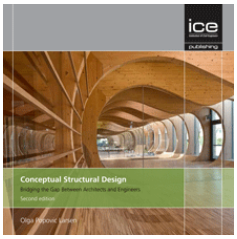
Σπύρος Παυλίδης

Η δεύτερη έκδοση του βιβλίου «Γεωλογία των Σεισμών», πραγματεύεται θέματα από το χώρο των γεωεπιστημών για τη σπουδή και κατανόηση των «σύγχρονων» και «πρόσφατων» γεωλογικών δομών και διεργα-

σιών, που έχουν άμεση σχέση με το γεωλογικό φαινόμενο του σεισμού. Κύριο αντικείμενο αυτής της προσπάθειας αποτελούν τα ενεργά ρήγματα, (ορισμός, χαρακτηρισμός, χαρτογράφηση και η μελέτη τους). Η διεπιστημονική προσέγγιση της μελέτης των πρόσφατων κινήσεων του φλοιού της γης, γίνεται κυρίως από την πλευρά της Μορφοτεχνικής, Ποσοτικής Νεοτεκτονικής Ανάλυσης, Παλαιοσεισμολογίας και Σεισμοτεκτονικής, με τη συμβολή και άλλων επιστημονικών κλάδων, όπως Τεκτονικής Γεωδαισίας, Τηλεπισκόπησης, Αρχαιοσεισμολογίας κ.ά. Στις σελίδες του βιβλίου δίνονται αρκετά παραδείγματα νεοτεκτονικών - σεισμικών δομών από την Ελλάδα και άλλες χώρες με έντονη ενεργό τεκτονική σεισμικότητα καθώς και εκτεταμένη βιβλιογραφία για περαιτέρω μελέτη. Απευθύνεται βασικά στους προπτυχιακούς φοιτητές της Γεωλογίας που διδάσκονται το μάθημα της Νεοτεκτονικής, αλλά και σε μεταπτυχιακούς φοιτητές ή άλλους επιστήμονες, που ασχολούνται με θέματα Τεκτονικής Γεωλογίας, Γεωμορφολογίας, Σεισμολογίας Γεωφυσικής, Τεχνικής Γεωλογίας, Γεωθερμίας, Τεκτονικής Γεωδαισίας, Εδαφομηχανικής κ.ά.

Ο Σπύρος Β. Παυλίδης είναι Καθηγητής στο τμήμα Γεωλογίας του Αριστοτελείου Πανεπιστημίου Θεσσαλονίκης με ειδίκευση στη Νεοτεκτονική και Παλαιοσεισμολογία.

(University Studio Press, 2016)



Conceptual Structural Design: Bridging the Gap between Architects and Engineers

Second edition

Olga Popovic Larsen

Conceptual Structural Design aims to 'bridge the gap' between engineers' and architects' understanding of structural form and highlight the importance of close collaboration between all members of the design team throughout a project.

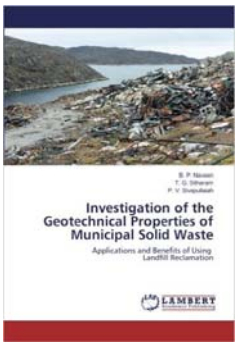
This book is presented in two parts. The first part is theoretical and investigates source of inspiration for developing structural form, learning from natural forms, applying our own intuition, seeking inspiration from precedents, applying understanding of structural principles, developing design through physical models, and using new design tools, construction methods and materials to develop new structural forms. The second part of the book is presented through a selection of case studies which include interviews with the design teams.

Conceptual Structural Design, Second edition:

- Describes the immense development in design tools, construction methods and materials and how these have impacted upon the way designers think, perceive and design structures,
- Reflects on the development in knowledge, skills and opportunities which affect the design team and the importance of embracing sustainability agendas.
- Includes a selection of case studies which outline architects' experiences from real projects and how they collaborated with engineers from the early stages of design.

The second edition of *Conceptual Structural Design* is essential reading for architects and engineers, and for anyone interested in conceptual structural design.

(ICE Publishing, 04.10.2016)



Investigation of the Geotechnical Properties of Municipal Solid Waste

Applications and Benefits of Using Landfill Reclamation

B P Naveen, T G Sitharam, P V Sivapullaiah

Geotechnical characterization plays a major role in the rehabilitation of waste dumps. Because the rising cost of land has made it necessary to utilize the waste dumps and development of methods for construction and assessment based on the geotechnical properties of wastes. Geotechnical properties of waste play a vital role in the reclamation of the landfill. For this, it is necessary to evaluate geotechnical properties by appropriate methods as most of the geotechnical testing may not be directly applicable. Also, there is a potential threat to groundwater and surface water bodies from leachates generated from the waste for a prolonged period. This book describes a detailed field and laboratory study performed to evaluate the geotechnical properties of the municipal solid wastes in the Mavallipura landfill in Bangalore and characteristics of leachate generated by the same. Also, the shear modulus reduction and damping ratio curves for Mavallipura landfill has been developed using laboratory measured values and validated with semi-empirical methods.

(LAMBERT Academic Publishing, November 1, 2016)

ΗΛΕΚΤΡΟΝΙΚΑ ΠΕΡΙΟΔΙΚΑ

www.geoengineer.org

Κυκλοφόρησε το Τεύχος #139 του **Newsletter του Geoengineer.org** (Νοεμβρίου 2016) με πολλές χρήσιμες πληροφορίες για όλα τα θέματα της γεωμηχανικής. Υπενθυμίζεται ότι το Newsletter εκδίδεται από τον συνάδελφο και μέλος της ΕΕΕΕΓΜ Δημήτρη Ζέκκο (secretariat@geoengineer.org).

Ενδεικτικά αναφέρονται:

- Earthquake Measuring 6.9 Strikes Papua New Guinea
- Project Summary in the city of Memphis about Riverside Drive Slope Stabilization
- Colima Volcano in Mexico Erupts Causing Evacuations
- Combining geological modelling and BIM for infrastructure
- Shallow 5.3 Magnitude Earthquake Strikes Greece
- Energy Plant Dam Collapses Due to Flooding in North Carolina (video)

http://campaign.r20.constantcontact.com/render?m=1101304736672&ca=81610ba2-1c71-472c-9d32-4b8e25ad0221

International Journal of Geoengineering Case Histories
Journal of the International Society for Soil Mechanics and Geotechnical Engineering

The International Journal of Geoengineering Case Histories, an official Journal of the International Society for Soil Mechanics and Geotechnical Engineering (ISSMGE), is pleased to announce the publication of Issue #3 of Volume #4 of the International Journal of Geoengineering Case Histories, an official Journal of the International Society for Soil Mechanics and Geotechnical Engineering (ISSMGE). This is a special issue with Case Histories on geotechnical engineering instruction, guest edited by Associate Professor Marina Pantazidou of the National Technical University of Athens.

- Editorial, pp. 203-204 Author: Marina Pantazidou
- Upward Integration of Geotechnical Curricular Content Using a Project in Seattle, Washington, USA, Page: 205-221 Author: Allen L. Jones
- Teaching Consolidation: Case Study of Preloading with Vertical Drains, pp.222-233 Authors: Robb E. S. Moss, Judd King and Gregg L. Fiegel
- The May 25th 2011 Railroad Embankment Failure in Ann Arbor, Michigan, As a Means for Teaching Geotechnical Engineering, pp. 234-245 Authors: Dimitrios Zekkos, Adda Athanasopoulos-Zekkos, Athena Grizi and William Greenwood
- Geotechnical Design of Embankment: Slope Stability Analyses and Settlement Calculations, pp. 246-261 Authors: Vasiliki Xenaki, George Doulis and George Athanasopoulos

ITACET Foundation
Foundation for Education and Training on Tunnelling and Underground Space Use

Newsletter #25 - November 2016
https://www.itacet.org/newsletter-25-november-2016

Κυκλοφόρησε το Τεύχος 25 (Νοεμβρίου 2016) με τα παρακάτω περιεχόμενα:

- President's Address
- Coming soon:
  - Mechanized Tunnelling in Soft Soil
  - Health & Safety & Logistic in Tunnel Construction
  - Risk Management
  - Mechanized Tunnelling: Challenging Case Histories
- Next events in preparation:
  - Utility Tunnels - April 2017 - Chengdu (China)
- Events Report
  - Mechanized Tunnelling in Soft Soil, September 13th, Buenos Aires, Argentina
  - Planning & Design in Conventional Tunneling, October 17th-18th, Thimphu, Bhutan
  - Risk management and contractual practices, October 29th, Kathmandu, Nepal

ΕΚΤΕΛΕΣΤΙΚΗ ΕΠΙΤΡΟΠΗ ΕΕΕΕΓΜ (2015 – 2018)

Πρόεδρος	:	Γεώργιος ΓΚΑΖΕΤΑΣ, Δρ. Πολιτικός Μηχανικός, Καθηγητής Ε.Μ.Π. president@hssmge.gr, gazetas@ath.forthnet.gr
Α' Αντιπρόεδρος	:	Παναγιώτης ΒΕΤΤΑΣ, Πολιτικός Μηχανικός, ΟΜΙΛΟΣ ΤΕΧΝΙΚΩΝ ΜΕΛΕΤΩΝ Α.Ε. otmate@otenet.gr
Β' Αντιπρόεδρος	:	Μιχάλης ΠΑΧΑΚΗΣ, Πολιτικός Μηχανικός mpax46@otenet.gr
Γενικός Γραμματέας	:	Μιχάλης ΜΠΑΡΔΑΝΗΣ, Πολιτικός Μηχανικός, ΕΔΑΦΟΣ ΣΥΜΒΟΥΛΟΙ ΜΗΧΑΝΙΚΟΙ Α.Ε. mbardanis@edafos.gr, lab@edafos.gr
Ταμίας	:	Γιώργος ΝΤΟΥΛΗΣ, Πολιτικός Μηχανικός, ΕΔΑΦΟΜΗΧΑΝΙΚΗ Α.Ε.- ΓΕΩΤΕΧΝΙΚΕΣ ΜΕΛΕΤΕΣ Α.Ε. gdoulis@edafomichaniki.gr
Έφορος	:	Γιώργος ΜΠΕΛΟΚΑΣ, Δρ. Πολιτικός Μηχανικός, Επίκουρος Καθηγητής ΤΕΙ Αθήνας gbelokas@teiath.gr, gbelokas@gmail.com
Μέλη	:	Ανδρέας ΑΝΑΓΝΩΣΤΟΠΟΥΛΟΣ, Δρ. Πολιτικός Μηχανικός, Ομότιμος Καθηγητής ΕΜΠ aanagn@central.ntua.grn
		Βάλια ΞΕΝΑΚΗ, Δρ. Πολιτικός Μηχανικός, ΕΔΑΦΟΜΗΧΑΝΙΚΗ Α.Ε. vxenaki@edafomichaniki.gr
		Μαρίνα ΠΑΝΤΑΖΙΔΟΥ, Δρ. Πολιτικός Μηχανικός, Αναπληρώτρια Καθηγήτρια Ε.Μ.Π. mpanta@central.ntua.gr
Αναπληρωματικό Μέλος	:	Κωνσταντίνος ΙΩΑΝΝΙΔΗΣ, Πολιτικός Μηχανικός, ΕΔΑΦΟΜΗΧΑΝΙΚΗ Α.Ε. kioannidis@edafomichaniki.gr
Εκδότης	:	Χρήστος ΤΣΑΤΣΑΝΙΦΟΣ, Δρ. Πολιτικός Μηχανικός, ΠΑΝΓΑΙΑ ΣΥΜΒΟΥΛΟΙ ΜΗΧΑΝΙΚΟΙ Ε.Π.Ε. editor@hssmge.gr, ctsatsanifos@pangaea.gr

ΕΕΕΕΓΜ

Τομέας Γεωτεχνικής
ΣΧΟΛΗ ΠΟΛΙΤΙΚΩΝ ΜΗΧΑΝΙΚΩΝ
ΕΘΝΙΚΟΥ ΜΕΤΣΟΒΙΟΥ ΠΟΛΥΤΕΧΝΕΙΟΥ
Πολυτεχνειούπολη Ζωγράφου
15780 ΖΩΓΡΑΦΟΥ

Τηλ. 210.7723434
Τοτ. 210.7723428
Ηλ-Δι. secretariat@hssmge.gr ,
geotech@central.ntua.gr
Ιστοσελίδα www.hssmge.org (υπό κατασκευή)

«ΤΑ ΝΕΑ ΤΗΣ ΕΕΕΕΓΜ» Εκδότης: Χρήστος Τσατσανίφος, τηλ. 210.6929484, τοτ. 210.6928137, ηλ-δι. ctsatsanifos@pangaea.gr, editor@hssmge.gr, info@pangaea.gr

«ΤΑ ΝΕΑ ΤΗΣ ΕΕΕΕΓΜ» «αναρτώνται» και στην ιστοσελίδα www.hssmge.gr